Popular Astronomy.

Vol. XXV, No. 10. DECEMBER, 1917. Whole No. 250.

ZENITH METEORS.

WILLIAM H. PICKERING.

Of the many hours that have been spent by individual observers in studying meteors, nearly all have been devoted to a location of their radiants. The great majority of these, owing in part to the northern latitude of the stations of the observers, are located in the northern hemisphere. Thus of 176 radiants determined by C. P. Olivier, who observed mainly in latitudes $+37°$ and $+38°$, 12, or only 7 per cent, are located south of the celestial equator (Trans. Amer. Phil. Soc. N.S. 22 Part 1.) If an observer whose equator reached an altitude of 52° and 53° found so few southern radiants, the question might well be asked, is not this small ratio due at least in part to a real lack of radiants south of it?

During the first few months of his stay in Jamaica the writer was able to devote a few hours to meteoric research. With the very limited time at his disposal, it seemed to him that instead of spending it in determining the location of a few radiants, many of which would undoubtedly be already known, it would be better to expend it in an exclusive study of those meteors which passed near his zenith, the object of this investigation being to determine the original general direction of their motion in different portions of the Earth's orbit with regard to the ecliptic. During the interval in question, from January to April 1912, the ecliptic during the early evening hours passed very near the zenith. For the first three months it was generally a few degrees to the north of that point, and never did it get as far as 20° to the south of it.

It was proposed to record only those meteors passing within 30° of the zenith, whose apparent paths would therefore be but little affected by the attraction of our Earth, and to determine whether most of them

came from the north or the south of the ecliptic. A record was also kept of the relative numbers coming from the east and the west. Since most meteoric orbits are retrograde, and the motion of the Earth itself is towards the east, we should naturally expect much the largest number to come from that direction.

In order to avoid systematic errors based on the position of the observer, he reclined in a steamer chair, the front legs of which were supported on a box, thus maintaining his body in a horizontal position. The chair was arranged to be parallel to the plane of the ecliptic in order that the observations should refer to latitude rather than to declination, and he lay for alternate half hours facing the east and the west. Observations were made only occasionally, and only on those nights when eleven Pleiades were visible to the naked eye, which was about half the time. The majority of meteors seen that were as faint as the sixth magnitude were rejected, only those being retained whose paths were well observed.

Table I contains a general statement of the data secured, the successive columns giving the date, the Eastern Standard Time, the duration of the search, the number of meteors seen, and the average time expended per meteor. In the third column one minute was allowed for each meteor for the time spent in recording it, so that the actual observed interval was really greater to this extent. The total time expended in the search was a little over 19 hours on 23 nights, the number of meteors recorded 105, and the average time between them 10.9 minutes, so that in the early evening hours during those months when the fewest meteors are usually visible, we saw and recorded them at the rate of five and a half per hour.

TABLE I.

DATA OF THE OBSERVATIONS.

1912	E.S.T.	Dur.	No.	Rate	1912	E.S.T.	Dur.	No.	Rate
	h m	m	m	m		h m	m	m	m
Jan. 18	8 04	58	4	14	Feb. 23	9 25	30	5	6
19	8 00	33	2	16	Mar. 19	9 25	30	1	30
21	8 12	92	4	23	20	9 34	52	6	9
23	9 10	63	8	8	21	11 20	64	14	5
24	9 18	58	5	12	22	9 09	40	4	10
25	8 27	34	1	34	23	10 32	62	7	9
Feb. 8	8 28	62	0	∞	Apr. 6	10 34	21	4	5
10	9 36	65	6	11	7	10 23	30	4	8
11	9 28	65	5	13	14	9 50	30	1	30
12	9 18	62	4	16	16	9 59	38	1	38
15	9 51	30	7	4	21	10 33	61	9	7
19	9 30	70	3	23			1150	105	10.9

A list of meteors was prepared, the successive columns giving the number, the date, the direction from which the meteor came, either north or south, east or west, the length of the visible path, and the magnitude. Of the 105 meteors recorded 42 came from the north, 47 from the south, and of 16 the direction was so nearly east or west that the meridional component was indeterminate, The relative percentages are 40, 45, and 15. It therefore appears that there is no lack of meteors coming from the south of the ecliptic between longitudes 60° and 180°. In order to complete the research for other longitudes, however, observations from a southern station are necessary.

Of the 105 meteors, 75 came from the east, 18 from the west, and of 12 the direction was indeterminate. The percentages are 71, 17, and 12. Over 4 meteors come from the east, to 1 from the west. Our expectations in this respect were therefore verified. One reason that this ratio was not even greater, as might perhaps have been expected, was that the swifter meteors from the east were burned up and extinguished at a greater altitude than the slower moving ones from the west, and were thus more remote from the observer. Meteors rising towards the zenith from the eastern quarter of the heavens are by no means uncommon, if we look for them at a sufficient altitude.

We recorded one meteor of zero magnitude, 4 of the first, 13 of the second, 22 of the third, 25 of the fourth, 30 of the fifth, and 10 of the sixth. Reducing these numbers to percentage we have 1, 4, 12, 21, 24, 28, and 10 per cent. It was recorded that 38 of the paths were at least 20° in length. Of these 33 belonged to meteors coming from the east, 2 to meteors coming from the west, and 3 were indeterminate. These figures indicate the high speed of the eastern meteors relatively to the earth, the western ones falling in a more nearly vertical direction. Of the two above mentioned coming from the west one had a large northerly, the other a large southerly component. On March 20 and 21 and April 7 four to six southern meteors were observed each night, coming at the rate of one every eight to eleven minutes. Nearly half of them seemed to radiate from Virgo.

Mandeville, Jamaica, B. W. I.
November 1, 1917.

ARE THE SPIRAL NEBULAE MILKY WAYS?

(A Translation by Charles Nevers Holmes of an article by M. G. Renaudot, in *L'Astronomie*, June, 1917.)

The hypothesis according to which the spiral nebulæ are supposed to be remote Milky Ways similar to our own stellar universe, like "islands" amidst sidereal space, of which each constituent particle would be a sun, and perhaps the center of a particular system immersed in another combined system, immensely vaster, has been recently discussed by Dr. Crommelin in *Scientia*.

During these later years, this hypothesis has been strengthened considerably by the discovery that a great number of non-gaseous nebulæ assume the spiral form and, also, by the accumulation of proofs that our own system presents a similar structure. Photographic examination, spectroscopic investigation and mathematical analysis furnish some important arguments for this theory. The "planétésimale hypothesis" formulated by Messrs. Moulton and Chamberlin adds to it a particularly suggestive contribution. According to this hypothesis, the spiral nebulæ are supposed to be the result of tremendous disturbances, indicated by sorts of tides produced in a globular gaseous mass by the passage, more or less near, but without contact, of another analogous mass. While direct collisions are, doubtless, excessively rare, these disturbing close approaches must be extremely frequent, a fact which would explain the very considerable number of nebulæ observed in spiral form.

The spiral form cannot, moreover, last indefinitely. This would be only a stage of development. For, if the central mass is large and potent, and the dispersion moderate, the interior regions should have to move much more rapidly than the external zones and the helices will then tend to flatten into a disc, resulting in the planetary nebulæ.

One of the chief objections opposed to this theory is that these nebulæ are mostly grouped in the vicinity of the galactic poles, particularly towards the north pole, suggesting a connection with our Milky Way. But Mr. Crommelin remarks that the diminution in the number of spiral nebulae, and also their apparent absence towards the galactic plane, can be attributed to the possible existence of an obscuring matter forming a screen before these nebulæ, a kind of opaque curtain whose abundance would increase towards the galactic plane. Besides, if these spiral nebulæ were situated within our system, they would probably group themselves around an axis crossing the center of the

PLATE XXII

THE GREAT SPIRAL NEBULA, MESSIER 51, IN THE CONSTELLATION *Canes Venatici*

Photographed by G. W. Ritchey with the 2-foot Reflector of the Yerkes Observatory, June 3, 1902.

Milky Way, this center being, according to Charlier, at a distance of 300 light-years from the Sun, in the direction of the southern constellation of Argo (region of the Keel)—and not symmetrically around an axis passing through the Sun itself, and perpendicular to the galactic plane. The hypothesis according to which the spiral nebulæ would be emanations expelled by some force of projection outside of our system becomes inadmissable in consequence of the discovery of extraordinary radial velocities by which these nebulæ are animated, velocities much superior to all those observed in the most rapid celestial bodies moving inside of the Milky Way. Thus, Mr. Slipher, at the Lowell Observatory, has ascertained that the nebula in Andromeda is approaching the Sun at the rate of 300 kilometres per second. He has found a radial speed of 1100 kilometres to the second for the nebula having the number 4594 in the New General Catalogue, and a rapid rotation. Mr. Pease, at Mount Wilson, having repeated these measures, has obtained 1180 kilometres per second for the radial velocity of this same nebula, and 330 kilometres per second for its speed of rotation at 2′ from the center. A singular observation: this velocity of rotation seems to vary proportionately with the distance from the center, as if the nebular system were rigid and all turned in a mass, a thing which is absolutely incompatible with the vast dimensions of these masses.

I am rather of the opinion, adds Mr. Crommelin, that the substance is arranged in such a manner that the attraction, in each of its parts, is proportional to the distance from this part to the center, from which it results that the period is the same for all distances.

Another indication in favor of the existence of Milky Ways outside of our own is given by the recent measurements of nebular distances. If we admit that spiral nebulæ are the result of a meeting of two globular masses, it is not without interest to note that the distances calculated for certain of these masses exceed by a good deal the extent assigned to our Milky Way. Thus, Mr. Harlow Shapley, at Mount Wilson Observatory, has found that the parallax of the famous cluster in Hercules (Messier 13), visible to the naked eye, is less than 0″.0001. Its distance would be then about 100,000 light-years, at least, and its diameter would be about 1,000 light-years, that is to say, of the same order as that of our own cluster of stars.

Let us recall that a light-year equals 9,467,280,000,000 kilometres.

From all these considerations, Mr. Crommelin concludes that the spiral nebulæ are probably Milky Ways outside of our own Galaxy, but still analogous to it, of dimensions comparable with its own extent, but whose development is at a stage of evolution less advanced than that of our system, a great part of their substance being still scattered and spread out in clouds which partially reflect the stellar light.

41 Arlington St., Newton, Mass.

HOW TO DETERMINE THE CORRECT TIME WITHOUT APPARATUS AND WITHOUT KNOWING THE MERIDIAN.

ERNESTO NELSON.

When two plumb lines about ten feet in length are hung from the ends of a rod two feet long, placed in a direction approximately north and south, a plane is determined which forms an angle with the meridian plane. If the threads are fine enough (silk threads answer the purpose) and are adequately secured at their lower ends to avoid oscillation, it will be easy to observe the passing of a star when the latter places itself on the same line with the threads, that is, when it crosses the plane formed by the threads. To insure a correct observation the threads should be conveniently lighted and the observer's head should rest firmly against a chair, or post, in order to avoid unsteadiness of the eye.

To record the time of our watch at the moment of the transit of a star behind the threads a small flashlight battery can be used with which to light the watch at the precise moment, or the beats of the watch can be counted from the moment of transit until we can approach a convenient source of light.

Such plane as the one described above serves for the observation of transits of stars belonging to either half of the sky (considering the latter divided into two halves by a great circle perpendicular to the meridian at the zenith). It must be borne in mind that for an observer placed at the equator the southern half of the sky would contain only stars of the southern hemisphere, the northern half of the sky containing, on the other hand, all stars of the northern hemisphere. But if the observer is placed, let us suppose, in northern latitudes, a fringe of the northern celestial hemisphere will form part of the southern half of the sky. If the observer is placed somewhere south of the equator, he will see a part of the southern hemisphere as a part of the northern half of the sky visible to him.

It is easy to see that if the plane determined by the two verticals were coincident with the meridian plane, the time elapsed between the successive transits of any two stars would be found to be equivalent to the difference in their right ascensions as given by the nautical

almanacs. But as our material plane will necessarily form an angle with the meridian, the actual time elapsed between the observations will be either longer or shorter than the expected interval according to the direction in which the material plane is turned with regard to the meridian plane.

When observing the transit of a pair of stars through the plane of the threads five cases may occur: (*a*) the pair of stars belong to opposite hemispheres and are seen in opposite halves of the sky; (*b*) they belong to the same hemisphere but they are observed in opposite halves of the sky; (*c*) they belong to the same hemisphere and are seen in the same half of the sky; (*d*) they belong to opposite hemispheres and are seen in the same half of the sky; (*e*) one of the stars is a circumpolar and is seen at the moment of its *lower transit.*

Observations with Stars in Opposite Halves of the Sky.

(*a*) Both stars of the pair belong to opposite hemispheres.

Let us suppose the rod is pointing in the direction N.E.-S.W. We may call this mode of deviation a clockwise deviation. In such a case the northern star will be in line with the threads before its culmination and the southern star will be seen behind the threads after its culmination. Furthermore, if the northern star precedes the southern star in its transit (i. e., if its right ascension is westward with respect to that of the southern star), the shifting of the plane will result in lengthening the interval between the transits. If, on the other hand, the southern star is west of the northern star, the shifting will result in shortening the interval sometimes to the extent of inverting the order of transits.

How to Determine the Sense of Deviation of the Plane.

When the southern star precedes the northern star in its transit, it will be found that the observed interval may be shorter or longer than the computed interval. The first occurrence is an indication that the plane of the threads is deviated clockwise; the latter that the deviation is in the opposite direction. If, on the other hand, the northern star precedes the southern star in its transit the above conditions are reversed.

The following synoptic arrangement covers all possible cases:

Southern transit first	Obs. time $<$ expected time or order of transits inverted means clockwise deviation
	Obs. time $>$ expected time means deviation contrary to the hands of a clock
Northern transit first	Obs. time $>$ expected interval means clockwise deviation
	Obs. interval $<$ computed interval or order of transits inverted means deviation contrary to the hands of a clock.

The difference between the intervals, observed and computed, is here called discrepancy. Calling T the longer interval of time (observed or computed) and t the smaller, we have $D = T - t$. In case, however, the order of transits is inverted, the discrepancy is equivalent to the sum of the intervals.

We may represent by n and s the time elapsed either before or after the transit of the northern or southern stars and their passing by the planes of the threads. As already explained, the discrepancy is equivalent to the sum $n + s$ save in the case of inversion in the order of transits.

To solve the problem, all we need is to know the watch time at the moment of the transit of any of the stars. This we are able to determine if we can find the values of either n or s. By adding or subtracting, as the case may be, any of those values to or from the time recorded at the crossing of the respective star behind the threads we shall know the time marked by the watch *at the moment either star culminated.* Comparing the watch time with the correct time as given in the astronomical almanacs for the culminations of the stars we have chosen for the observations, we can easily convert the astronomical time into civil time provided we know the longitude of the place with respect to that of Washington.

The observation plane determines in the celestial sphere a great circle which forms an angle with the meridian circle. The zenith is the apex of such angle, the sides of which intercept the celestial parallels in segments of increasing length as the horizon is approached. The time taken by the stars in covering the distance between the plane of the meridian and the plane of observation is therefore variable. Our problem is to find the value of n or s from the sum of these quantities, namely, the time of discrepancy.

It is easy to demonstrate that the time taken by any star in covering the segment of parallel intercepted by the two planes is in direct ratio to the zenithal distance of the star and in inverse ratio to the complement of its declination*

If we call z_n and z_s the zenithal distances of a northern and a southern star respectively, d_n and d_s their respective declinations, and remembering that the distance from the zenith to the equator is equivalent to the latitude of the place, L, we have:

$$z_n = d_n - L$$
$$z_s = d_s + L$$

* The farther a star is from the zenith the longer the distance between the sides of the angle. On the other hand, the farther a star is from the pole of its hemisphere, i. e., the greater the complement of its declination, the greater the apparent velocity of its motion.

Substituting the value of z_n and z_s, we have, for the time taken by two stars in covering the segments of parallels:

$$\frac{n}{s} = \frac{\frac{d_n - L}{90 - d_n}}{\frac{d_s + L}{90 - d_s}} = \frac{\frac{1}{90 - d_n}(d_n - L)}{\frac{1}{90 - d_s}(d_s + L)}.$$

The expressions $\frac{d_n - L}{90 - d_n}$ and $\frac{d_s + L}{90 - d_s}$ are constant for every star n the same latitude and may be called indexes of apparent displacement. Calling I_n and I_s the indexes of apparent displacement of two stars belonging to the northern and southern halves of the sky respectively, we have (calling D the discrepancy)

$$\frac{D}{I_n + I_s} = \frac{n}{I_n} = \frac{s}{I_s},$$

from which we may deduce the value of either n or s.

To avoid tedious calculations we annex to this article a table giving the values of $\frac{1}{90 - d}$ for any degree of declination of the star, a value which will have to be multiplied by either $(d_n - L)$ or by $(d_s + L)$ in order to obtain rapidly I_n or I_s.

The values of n or s having been found, it will be easy to know the time our watch was indicating when either of the stars made its transit of the meridian. By comparing the latter with the time given by the tables we know how much the watch is fast or slow.

(*b*) Both stars of the pair belong to the same hemisphere and are observed in opposite halves of the sky.

In this case the zenith distance of the star which is between the equator and the zenith is

$$z = L - d,$$

and therefore its index is

$$I = \frac{L - d}{90 - d}$$

Observations with Stars in the Same Half of the Sky.

(*c*) The pair belong to the same hemisphere.

Although we have referred to stars belonging to both halves of the sky for the calculation of the correct time, the latter can also be

deduced from the observations of two stars belonging to the same side of the sky. In such a case, calling n and n' the segments of parallels corresponding to two northern stars, the value of the discrepancy will be found to be the difference between the quantities n and n' (the minuend being the larger of the two).

Supposing $I_n > I_n'$, the value of either n or n' is deduced from the proportion:

$$\frac{D}{I_n - I_n'} = \frac{n}{I_n} = \frac{n'}{I_n'}$$

(*d*) The stars of the pair belong to opposite hemispheres.

In this case the above conditions apply, except that the index of the star between the equator and the zenith is, as in case (*b*):

$$I = \frac{L - d}{90 - d}$$

(*e*) One of the stars is at its lower culmination.

When the side to which the threads are deviated is known, the above observations can be supplemented by observing the *lower transit* of a circumpolar star. In such a case it will be found that the index of such a star is represented by the expression

$$\frac{180 - (d + L)}{90 - d}$$

in which the numerator represents the zenithal distance of the star.

The apparent motion of a circumpolar star at its lower transit being from west to east it is easy to see that when we use a circumpolar star at its lower transit in conjunction with a star belonging to the opposite half of the sky, the deviation of the plane of the threads will have the same effect upon both stars, that is, we shall see both either before or after their culmination. In that case,

$$D = T - t; \text{ and also, } D = n - s \text{ or } s - n$$

the minuend always being the quantity corresponding to a star with a higher index.

The value of either n or s is then deduced from the following formula in which we suppose $I_n > I_s$:

$$\frac{D}{\frac{180 - (d_n + L)}{90 - d_n} - \frac{d_s + L}{90 - d_s}} = \frac{n}{\frac{180 - (d_n + L)}{90 - d_n}} = \frac{s}{\frac{d_s + L}{90 - d_s}}$$

In case the other star used in connection with the circumpolar is in the same half of the sky as the latter, the discrepancy D also equals the difference between the observed and computed intervals except when the order of transits is inverted, in which case D equals the sum of the intervals.

When no inversion of the order of passages occur, the values of n and n' (n corresponding to the circumpolar) bear the following relation to D:

$$D = n + n' \quad \text{and} \quad \frac{D}{I_n + I_n'} = \frac{n}{I_n} = \frac{n'}{I_n'}$$

When inversion takes place, supposing $I_n > I_n'$

$$D = n - n' \quad \text{and} \quad \frac{D}{I_n - I_n'} = \frac{n}{I_n} = \frac{n'}{I_n'}$$

The following example will help to understand the procedure:

Place of observation: 31° 20′ N. L. 1° 17′ west of Washington.

Stars selected for observation on the 25th of September 1916.

Stars	Right Ascension	Declination
	h m s	° ′ ″
ζ Capricorni	20 16 17	S 15 02 50
α Cephei	21 16 34	N 62 13 45
ε Pegasi	21 40 03	N 9 29 02
α Ursae Major	10 58 33	N 62 12

The tables give as the right ascension of the sun on the 25th of September at noon (Washington time) $12^h\ 16^m\ 44^s$.*

Subtracting the right ascension of the mean sun from the right ascension of the stars and converting astronomical time into civil time, we have the following list, to which is added the time at which the transits behind the threads occurred:

* The right ascension of the mean sun at noon (Washington time) on any date can be always obtained from the fact that every 365 days and six hours, approximately, the position of the sun is the same. The position of the mean sun on the first of January 1916 at noon was $18^h\ 40^m\ 07^s$ and it will be $18^h\ 43^m\ 06^s$ on the first of January 1917. From the above data knowing the number of days elapsed since those dates, the right ascension may be calculated on any day of the years mentioned.

Stars	Due to cross the meridian	Crossing of the threads
	h m s	h m s
ζ Capricorni	8 31 34	8 34 35
α Cephei	9 31 42	9 47 19
ε Pegasi	9 55 08	10 00 30
α Ursae Majoris	11 13 29	10 57 46

Computed and observed intervals.

		Comp. Int.	Obs. Int.	Discrepancy
		h m s	h m s	m s
α Cephei	ε Pegasi	0 23 26	0 13 20	10 06
	ζ Capricorni	1 00 08	1 12 35	12 27
	α Ursae Majoris	1 41 47	1 10 36	31 11
ε Pegasi	ζ Capricorni	1 23 34	1 25 55	2 21
	α Ursae Majoris	1 18 21	0 57 16	21 05
ζ Capricorni	α Ursae Majoris	2 41 55	2 23 11	18 44

According to what we have said, we infer that the plane of the threads is deviated counterclockwise. Therefore, α Cephei was seen after its culmination and ε Pegasi, ζ Capricorni, and α Ursae Major before the culmination.

The indexes of the four stars are the following:

α Cephei	1.088
ε Pegasi	0.273
ζ Capricorni	0.617
α Ursae Majoris	3.285

The pair α Cephei-ε Pegasi gives the following for α Cephei:

$$\frac{606^s}{1.088 + 0.273} = \frac{x}{1.088} \; ; \; x = 8^m\,8^s$$

The corresponding time for ε Pegasi is

$$606^s - 484^s = 1^m\,58^s$$

The pair α Cephei-ζ Capricorni gives for the latter:

$$\frac{747^s}{1.088 + 0.617} = \frac{x}{0.617} \; ; \; x = 4^m\,30^s$$

The above gives in turn a new value for α Cephei's delay:

$$747^s - 270^s = 7^m\,57^s$$

The pair α Cephei-α Ursae Majoris gives for α Cephei:

$$\frac{31^m\,11^s}{3.285 + 1.088} = \frac{x}{1.088} \; ; \; x = 7^m\,45^s$$

and for α Ursae Majoris:

$$31^m\ 11^s - 7^m\ 45^s = 23^m\ 26^s$$

The pair ε Pegasi-ζ Capricorni gives for the latter:

$$\frac{141^s}{0.6173 - 0.2732} = \frac{x}{0.6173}\ ;\ x = 4^m\ 12^s$$

and for ε Pegasi:

$$4^m\ 12^s - 2^m\ 21^s = 1^m\ 51^s$$

The pair ε Pegasi-α Ursae Major gives for ε Pegasi:

$$\frac{21^m\ 5^s}{3.285 - 0.273} = \frac{x}{0.273}\ ;\ x = 1^m\ 55^s$$

and for α Ursae Majoris:

$$21^m\ 5^s + 1^m\ 55^s = 23^m\ 0^s$$

The pair ζ Capricorni-α Ursae Majoris gives for the former:

$$\frac{18^m\ 44^s}{3.285 - 0.617} = \frac{x}{0.6173}\ ;\ x = 4^m\ 00^s$$

and for the latter:

$$18^m\ 44^s + 4^m\ 00^s = 22^m\ 44^s$$

As we see, by combining the pairs of stars we obtain a large number of values from which an average is then obtained. In the following table the readings of the watch are finally compared with the correct time:

Star	Observed Transits	Value of n or s	Watch time at transit	Transit due	Watch fast
	h m s	m s	h m s	h m s	m s
α Cephei	9 47 10	7 57	9 39 13	9 31 42	7 31
		8 08	9 36 02		7 20
		7 45	9 39 25		7 43
ε Pegasi	10 00 30	1 58	10 02 28	9 55 08	7 20
		1 51	10 02 21		7 13
		1 55	10 02 25		7 17
ζ Capricorni	8 34 35	4 30	8 39 05	8 31 34	7 31
		4 12	8 38 47		7 13
		4 00	8 38 35		7 01
α Ursae Majoris	10 57 46	23 26	11 21 12	11 13 29	7 43
		23 44	11 20 30		7 01
		23 00	11 20 46		7 17
				mean	7 20

Our watch was then $7^m\ 20^s$ fast with regard to the local time. The place being 1° 17′ west of Washington, or $5^m\ 8^s$ in time, the real difference with Washington time is $2^m\ 12^s$.

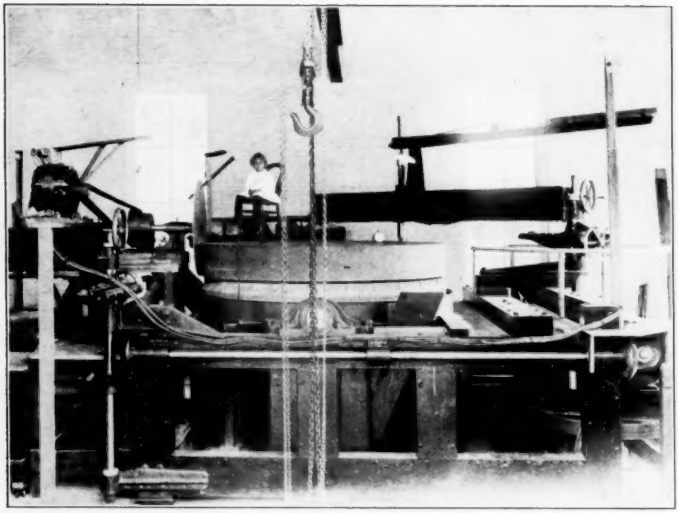
VALUE OF $\frac{1}{90-d}$

Declination d	$\frac{1}{90-d}$ (*)	Declination d	$\frac{1}{90-d}$	Declination d	$\frac{1}{90-d}$
0	0.01111	30	0.01667	60	0.03333
1	.01123	31	.01695	61	.03448
2	.01136	32	.01724	62	.03571
3	.01149	33	.01754	63	.03704
4	.01163	34	.01786	64	.03845
5	.01176	35	.01818	65	.04000
6	.01190	36	.01852	66	.04167
7	.01205	37	.01887	67	.04348
8	.01220	38	.01923	68	.04545
9	.01235	39	.01961	69	.04762
10	.01250	40	.02000	70	.05000
11	.01266	41	.02041	71	.05263
12	.01282	42	.02083	72	.05555
13	.01299	43	.02128	73	.05882
14	.01316	44	.02174	74	.06250
15	.01333	45	.02222	75	.06667
16	.01351	46	.02273	76	.07143
17	.01370	47	.02326	77	.07692
18	.01389	48	.02381	78	.08333
19	.01408	49	.02439	79	.09091
20	.01429	50	.02500	80	.10000
21	.01449	51	.02564	81	.11111
22	.01471	52	.02632	82	.12500
23	.01492	53	.02703	83	.14286
24	.01515	54	.02778	84	.16667
25	.01538	55	.02857	85	.20000
26	.01562	56	.02941	86	.25000
27	.01587	57	.03030	87	.33333
28	.01613	58	.03125	88	.50000
29	.01639	59	.03226	89	1.00000

* The value $\frac{1}{90-d}$ is to be multiplied by $(d + L)$ in case the star belongs to the opposite hemisphere; and by $x\ (d - L)$ when the star belongs to the same hemisphere.

Buenos Aires, Argentina.

PLATE XXIII



The Machinery used in the Rough Grinding of the 100-inch Disc

Note the relative sizes of the child and the disc.

THE 100-INCH TELESCOPE AT MOUNT WILSON.

JENNIE B. LASBY.

After nearly nine years of continuous work the mirror for the 100-inch telescope has been finished and is in its mounting at the summit of Mount Wilson. Since this is the greatest triumph of the optician's skill it may be of interest to the readers of this magazine to review its history.

The disc from which the mirror was fashioned was cast, early in 1908, in the factory at St. Gobain, France. This old town with its huge glass factories is now in ruins and what remains is in the hands of the Germans. The glass was packed just as it came from the mold and shipped to Galveston by water and from there transported to the workshops at Pasadena, where a building had been erected especially for the work of grinding and polishing.

The glass in its rough state weighed about five and one-half tons, was 101 inches in diameter and when examined was found to have been cast in three layers. This was due to the fact that there were no crucibles large enough to hold such a mass of molten glass and the pourings into the mold had been made as closely together as possible, but the expert optician could detect flaws that made it seem unwise to attempt the grinding of the disc. Two more attempts were made at St. Gobain, but word was sent to Pasadena that neither of the later attempts was as successful as the earlier one. Professor Ritchey then made a trip to France, but found that the mechanical obstacles at the factory made it impossible to pour so large a piece of glass from one crucible. Finally it was decided that work should proceed on the disc at Pasadena. It was placed upon the bed-plate of the grinding machine and Mr. W. L. Kinny and Mr. Dalton, to whose skill its final perfection is due, began the preliminary grinding. The surfaces were smoothed until it measured 100 inches in diameter and 13 inches in thickness.

This smoothing process was followed by the actual grinding of the concave surface. This was done by applying flour emery in water with wooden brushes covered with cheesecloth. No metal was allowed to touch the surface of the glass, lest minute particles of rust be deposited and cause scratches. The brushes revolved very slowly and with an even motion, working from the center to the circumference of

the disc. After the first cutting had been done and the depression was about an inch and a quarter deep at the center, the grinding was done with even greater care the emery solution was allowed to stand for a time and the liquid siphoned off so that only the very fine particles were allowed to touch the glass.

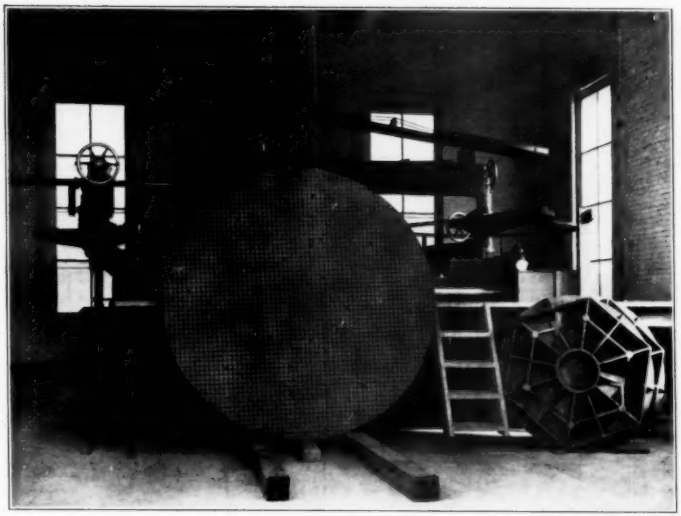
After the grinding was finished there remained the gigantic task of polishing the surface and this included a series of the most delicate and exhaustive tests. One of the earlier of the tests was to determine the effect of changes of temperature upon the glass. The temperature of the shop was lowered to 30° and then in a few days raised to 105°. In spite of the many defects in the structue of the glass, it was found that it was not harmed by this range when the change was gradual. Rapid changes, however, did affect the figure and as the polishing advanced it was found that the heat from friction made it necessary to discontinue the work for the day after a couple of hours.

While the glass was being polished an elaborate series of experimental tests were made each day to determine the result of the previous days work and to correct the adjustments of the tools. These tests were made with a 60-inch optically plane mirror, and the grinding of this mirror was in itself a huge task and took nearly a year. Over 600 of these tests were made during the three years of polishing. One very serious difficulty was encountered early in the polishing. It was found that the curves of concavity were not the same at right angles to each other or, in other words, there was astigmatism in the glass. The .0016 of an inch by which they differed threatened to render the glass useless, but after several months of work the problem was solved by the use of a new kind of tool. This was constructed in the form of a revolving plate as large as the glass itself and weighing 1500 pounds. It was so arranged that it would exert an even pressure on the entire surface of the glass and so corrected the tendency to astigmatism.

Early in the spring of 1917 the most rigorous tests failed to show any imperfection in the concavity of the surface and the glass was made into a mirror by chemical precipitation of silver from a solution poured over the surface.

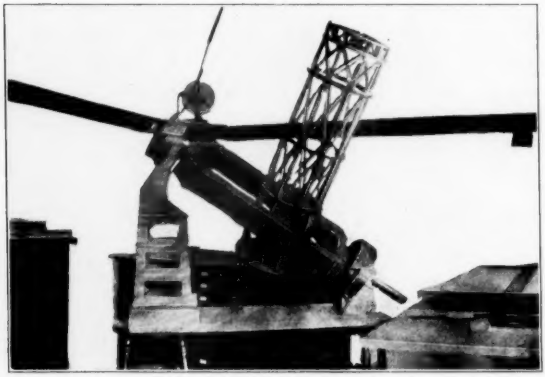
The task of transporting the four and one-half tons of glass up a mountain road, where it would be subject to jar and sudden changes of temperature, was no light one. It was lifted from the grinding table by a device such that the stress would be evenly distributed throughout the disc. Then it was lowered into an octagonal box which had been lined with paraffin paper and was sealed at every joint to exclude the dust. Inside the paper was a packing of carded wool and Brussels carpet to protect from heat and jolting. Only the very edge of the

PLATE XXIV



THE TOOL USED FOR APPLYING THE EMERY FLOUR IN POLISHING THE GREAT MIRROR

PLATE XXV



THE WORKING MODEL OF THE MOUNTING OF THE 100-INCH REFLECTOR

THE DOME FOR THE 100-INCH REFLECTOR OF THE MOUNT WILSON SOLAR OBSERVATORY

silvered surface touched anything. A corresponding rim of wood, faced with carpet and wool, had been placed inside the box cover and held the mirror rigidly in place when the cover was screwed down. The box was then hermetically sealed and encased in another layer of paraffin paper and clamped between parallel sets of heavy timbers with a steel bolt at the top for lifting. Even this did not seem enough and a cradle of heavy timbers was bolted on the bed of the motor and this was lined with cushions in which were heavy springs so that the box might oscillate easily. A strong canvas covered this and the trip was successfully made to the top of the mountain in one day.

Scarcely less interesting than the mirror itself is the mounting. The larger parts of this were constructed in a shipyard for battleships and the work was delayed very much by the increase activity in ship construction after the beginning of the war. The dome which shelters the telescope is 100 feet high, constructed of metal and has double walls, so that the temperature can be kept as even as possible. The lower 28 feet is stationary and the upper part rotates. Forty huge piers surrounding a still larger central pier supply the foundation. The main pier rests on a bed of sand six feet deep and carries a circular floor 52 feet in diameter. This has around its outer rim a metal wall nine feet high, to keep drafts from penetrating to the upper part of the dome. The moving parts of the telescope weigh 100 tons and the bulk of this weight is borne by pedestals floating in Mercury.

The driving clock has a weight of one and one-half tons and winds automatically every ten minutes. There is an elaborate system of electric controls, so that the observer can move the telescope any distance in any direction that he chooses, rotate the dome and move the platform without leaving his chair.

The telescope is fitted with a fine spectrograph and much of the work will probably be done with this instrument. Undoubtedly a large amount of work will be done in gathering data for Kapteyn's work on star-streams and to add to our knowledge of the structure and limits of the universe. The huge increase of light-gathering power should help materially in the study of star clusters and nebulae.

TWENTY-FIRST MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

[*Continued from page 606.*]

THE BEST SERVICE OF ASTRONOMERS IN TIME OF WAR.

BY GEORGE E HALE.

In the organization of the work of the National Research Council I have naturally given much consideration to the question of what service astronomers can render to the country during the period of the war. In Europe, as I found during a brief visit last summer, a number of astronomers have been engaged in war service. Count de la Baume Pluvinel has invented a device for detecting the presence of bits of shrapnel in the body; M. Chrétien was engaged on mathematical investigations bearing on the theory of airplanes; while M. Deslandres and other French astronomers were in the artillery service or otherwise occupied with military duties. In England the Astronomer Royal was engaged in the testing of certain instruments, Professor Newall had under construction a new type of range-finder for use against Zeppelins, and others were in active service with the army. Among these I may mention Mr. Capon, formerly of Oxford, who was at Mount Wilson during the early part of the war, and is now a prisoner in Germany, after having been wounded twice in the aviation service. In Italy, our former colleague Dr. Abetti, who is now in this country as the Italian representative of the French Scientific Mission, has done useful service at the Italian front in photographing the Austrian lines. Other cases might be mentioned, but these will suffice to indicate some of the kinds of work that astronomers may do.

In this country, although we have been constantly on the lookout for opportunities, few pieces of work have yet been found in which astronomers could advantageously take part. Comparatively few problems come to the National Research Council directly from the Government. Our experience has been similar to that of other departments of the Council of National Defense, which have made themselves useful by discovering and developing their own possibilities for service. Some of our committees have been very successful in this respect, but in astronomy the opportunities have been fewer than in almost any other field.

Surveying the various possibilities that seem to lie open to astronomers, we find that most of them may be grouped under the following heads: (1) instruction in navigation; (2) invention or development of military devices; (3) scientific service with the army; (4) statistical or other similar work for the Government. In addition to these possible services in which technical knowledge is of value, there is the opportunity, which has been embraced by some of our fellow members, of joining the fighting forces of the Army or Navy, and the possibility, regarding which I shall have more to say in a moment, of continuing astronomical research. Let us consider briefly the opportunities for usefulness in these various fields.

(1) *Instruction in Navigation.* A number of schools for instructing officers for the Emergency Fleet in navigation have been opened on the Atlantic and the Pacific Coasts. For the Atlantic Coast Professor A. E. Burton of the Massachusetts Institute of Technology is in charge of the work, while the instruction in navigation in the Pacific Coast stations is being organized by Professor Leuschner of the California State Council of Defense. Several well known members of the American Astronomical Society are taking part in this work as instructors, and there may still be opportunities for others who wish to join. The organization of this work does not fall within the field of the National Research Council, and application should be made to Professor Burton or Professor Leuschner.

(2) *Invention or Development of Military Devices.* Several astronomers have made useful suggestions to the National Research Council regarding devices of military importance. The nature of this work is such that most problems cannot be discussed publicly, but if any member of the American Astronomical Society has any suggestions to make he should send them to Major Robert A. Millikan, Chairman of the Physics Committee, who has immediate charge of this department of our work. This field is one in which originality and experience in the invention and design of instruments is evidently the prime requisite.

(3) *Scientific Service with the Army.* The Chief Signal Officer of the Army has recently asked the National Research Council to act as the advisory agent to the Signal Corps in the organization of various scientific services for the Army. Major Millikan, who has recently taken a commission in the Signal Corps in order to serve more effectively, is the representative of the Research Council in charge of this work. An important new branch of the Signal Corps, recently organized for service with the Army in France under the charge of Major Augustus Trowbridge of Princeton, will require the services of a considerable number of scientific men. Astronomers who have been accustomed

to the use of physical instruments might work very effectively in this group. It is suggested that any one who wishes to volunteer for such service should communicate with Major Robert A. Millikan, National Research Council, 327 Munsey Building, Washington, D. C.

(4) *Statistical or other Similar Work for the Government.* A new branch of Government work involving statistical investigations has recently been organized, in which, I had hoped that opportunities for astronomers experienced in statistics and computing would develop. Hitherto, however, such opportunities have not appeared, though the head of the service has been kept informed regarding available men. The same difficulty has existed in other classes of mathematical work: no problems falling in the fields in which astronomers have had special experience have yet presented themselves. In this connection it should be added, however, that the chief function of the National Research Council is to organize researches required for the solution of various specific problems, and not (except as above indicated) to act as an agency for finding the men required in various departments of the Government. The latter service has been rendered in part by the Intercollegiate Intelligence Bureau, and is now in the hands of a new division of the Department of Labor.

The patriotic example set by Major Fox, who has recently completed his training as an officer at Fort Sheridan, is an excellent illustration of what astronomers may do in the fighting forces of the Army. Others have already followed this example, and while one cannot consider such service for scientific men without mixed feelings, it will surely be a matter of satisfaction to the members of the American Astronomical Society to feel that they are to be so ably represented at the fighting front.

There remain to be considered the great majority of astronomers, whose duty and privilege it will be to carry forward their investigations during the period of the war. Recent events, both in Europe and the United States, have emphasized in the strongest manner the dignity and importance of scientific research. The tendency shown by some critics of limited view to measure the importance of research in terms of its immediate applicability to practical affairs is not justified by the facts. On the contrary, it is certainly fair to say that no science has done more for the world than astronomy. This is not chiefly because of its determination of the time, or the system of navigation it has developed, fundamentally important though these be. It is rather because of the sweeping change in human thought that astronomy has wrought and is still effecting, and the stimulating influence of the oldest of the sciences upon other sciences of later development. But I need not dwell on a theme which has been so luminously developed

by Poincaré in "La Valeur de la Science". In his demonstration of the importance of astronomy to the world we find ample justification for the work we are doing, and the strongest encouragement to continue its pursuit in the interest of national progress.

NOTES ON SOME SPECTROSCOPIC BINARIES.

By W. E. Harper.

20 π Cassiopeiae.

This star ($\alpha = 0^h\ 38^m$, $\delta = +\ 46°\ 29'$) was announced a spectroscopic binary by Professor Frost. It is of photographic magnitude 5.2 and type A5 with both component spectra showing. From 34 spectrograms secured at Ottawa the following elements have been determined.

$$
\begin{aligned}
P &= 1.96408 \text{ days} \\
e &= 0.009 \\
\omega_1 &= 45°.1 \\
\omega_2 &= 225°.1 \\
K_1 &= 117.76 \text{ km} \\
K_2 &= 117.40 \text{ km} \\
\gamma &= +\ 8.92 \text{ km} \\
T &= \text{J. D. } 2419970.035 \\
a_1 \sin^3 i &= 3,180,300 \text{ km} \\
a_2 \sin^3 i &= 3,170,500 \text{ km} \\
m_1 \sin^3 i &= 1.324\ \odot \\
m_2 \sin^3 i &= 1.328\ \odot
\end{aligned}
$$

29 Canis Majoris.

This star ($\alpha = 7^h\ 14^m$, $\delta = -\ 24°\ 23'$) also was announced by Professor Frost. Its visual magnitude is 4.77 and it is taken as the typical star of the class Oe. The emission band at λ 4688 was found to share with the absorption lines the shifts due to orbital motion. The K-line appears to have a very much smaller range than that given by the other lines which, by the way, is the largest yet discovered for any spectroscopic binary. The star would well repay further work at some southern observatory. The elements are:

$$
\begin{aligned}
P &= 4.3934 \text{ days} \\
e &= 0.156 \\
\omega &= 37°.64 \\
K &= 218.44 \text{ km} \\
\gamma &= -\ 12.12 \text{ km} \\
T &= \text{J. D. } 2417240.248 \\
a \sin i &= 13,035,000 \text{ km} \\
\frac{m_1 \sin^3 i}{(m+m_1)^2} &= 4.58\ \odot
\end{aligned}
$$

Boss 3511.

This star ($\alpha = 13^h\ 30^m$, $\delta = +\ 37°\ 42'$) was announced by Wright and Allen in *Lick Observatory Bulletin* 173. Thirty-one plates secured this summer give the elements:

$$
\begin{aligned}
P &= 1.61275 \text{ days} \\
e &= 0.067 \\
\omega &= 201°.5 \\
\gamma &= +7.09 \text{ km} \\
K &= 10.25 \text{ km} \\
T &= \text{J. D. } 2417018.145 \\
a \sin i &= 226,800 \text{ km} \\
\frac{m_1 \sin^3 i}{(m+m_1)^2} &= .00018 \odot
\end{aligned}
$$

ON THE PRESENCE OF THE RARE EARTHS IN α CANUM VENATICORUM.

By C. C. Kiess.

From a series of 67 spectrograms of α *Canum Venaticorum* secured at the Detroit Observatory over two hundred wave-lengths have been determined of the faint lines which characterize the spectrum of this star as being of Class Ap. Belopolsky has already pointed out the existence of two groups of variable lines in the spectrum. These groups have been verified and added to, and the identification of the lines with those of europium and terbium, respectively, has been indicated. In addition to the identification of the variable lines, many of the faint lines not definitely known to be variable have been identified with the stronger lines of yttrium, lanthanum, gadolinium and dysprosium.

RECENT WORK IN PHOTOGRAPHIC PHOTOMETRY.

By Edward S. King.

The recent systematic tests have been reduced and confirm the results found in *Harvard Annals* **59**, No. 6.

One aim has been to find the stellar magnitude of the various lamps employed in the tests, using yellow and blue light with view of determining the color index. Previous to this work I measured certain bright stars by the out-of-focus method using a yellow screen and yellow sensitive plates. The 8-inch Draper Telescope was used until it was superseded by the 10-inch Metcalf Triplet. In the reduction a discrepancy was met, which was caused by the interposition of the screen and by the difference in focus for yellow light existing between the two instruments. The means of determining the focus for each instrument was at hand in the plates themselves; by plotting the sizes of the images with respect to the focal settings. The advantage of the out-of-focus method is shown in that these measures could be perfectly determined although one instrument had been dismounted and removed from Cambridge.

The magnitudes found for these stars were based on *Polaris* having a visual magnitude of 2.12. On comparing these photo-visual values

with the visual magnitudes, a difference of 0.12 magnitude was found for stars having spectra of Class A. Since the photographic or blue magnitudes are made to agree with the visual magnitudes for Class A, it seems best to do the same for the photo-visual magnitudes, and accordingly I have corrected my values by 0.12 magnitude. Therefore, we have three values for *Polaris*:—Visual 2.12; Photographic 2.69; and Photo-visual 2.00. The photo-visual magnitude is subject to revision. By making the yellow as well as the blue values agree with the visual values for stars of Class A, I make such stars the standard of color, and shall be able to express the color of various sources of artificial light in such terms. Stars of Class A are thus our standard of color.

The lamp for comparison is set at a distance from the telescope and photographed out of focus on the same plate with the stars. The photographic magnitude of the Electric Lamp No. 1 furnished by the Bureau of Standards is about −12 at 1 meter, whereas the photo-visual magnitude is about −15, making a color index of 3. The Argand and Hefner Standards are redder. Another part of the out-of-focus work has been to photograph the planets with both yellow and blue light, which will give the color index of each.

PHOTO-ELECTRIC MEASURES OF NEW VARIABLE STARS.

By Jakob Kunz and Joel Stebbins.

A quartz potassium cell attached to a 12-inch telescope now gives accurate photometric results for stars as faint as photographic magnitude 5.5, the probable error of a single reading being usually about 1 per cent or less. Among the spectroscopic binaries studied, several have shown indication of light changes, as in the table below, but the range of variation may be considerably modified by further study.

H.R.	Star	Magnitude	Spectrum	Period days	Variation mag.	Remarks
4248	*ω Ursae Majoris*	4.84	A0	15.84	0.05	Eclipsing and continuous variation
5054	*ζ Ursae Majoris (Mizar)*	2.40	Ap	20.54	0.02	Continuous variation suspected
5062	*80 Ursae Majoris (Alcor)*	4.02	A5	0.155	—	No variation
5986	*θ Draconis*	4.11	F8	3.07	0.02	Eclipsing
6324	*ε Herculis*	3.92	A0	4.02	0.03	Eclipsing
6596	*ω Draconis*	4.87	F5	5.27	0.02	Eclipsing
7051	*η Lyrae*	5.06	A3	—	—	No variation
8541	*4 Lacertae*	4.64	B9	—	0.04	Period long
8640	*12 Lacertae*	5.18	B2	0.193	0.12	Continuous

A study has been made of the well known eclipsing variable λ *Tauri* which, in addition to the double system with period of 3.95 days, has a third component with a period of 34.6 days, discovered at Allegheny.

Most of the present results for this star are quite accordant, but there are a number of discordant observations, which when plotted on the 34-day period are found to be at two places on the curve separated by 17 days, or half the period. There is thus a strong probability of an effect of the third body, but the discrepancies do not indicate simple eclipses.

Observations of all of the foregoing stars are being continued.

MEASUREMENTS OF POSITION OF THE NUCLEUS OF THE GREAT NEBULA IN ANDROMEDA.

By C. O. Lampland.

For some years past a series of photographs of short exposure, with the 40-inch reflector of the Lowell Observatory, of the nucleus of the Andromeda Nebula have been made each year for the purpose of accumulating material to learn something in regard to the proper motion of this object. With suitable exposure and good seeing the nucleus is small and well defined, and should be susceptible of accurate measurement,

It seemed worth while at the present time to make use of some of the short-exposure photographs by earlier observers. In reply to an inquiry for carefully made copies of such photographs Mrs. Roberts very kindly sent on three original negatives with exposures of 10^m, 20^m and 40^m, made by the late Dr. Isaac Roberts with his 20-inch reflector. The measures of these negatives were to be compared with those from several of the best photographs with the 40-inch reflector. Some work on this material had been done when Professor Barnard's fine series of micrometric measures of the nucleus referred to three faint stars near it appeared in the *Astronomical Journal* No. 716. From his concordant observations with the great refractor of the Yerkes Observatory there appeared to be no satisfactory evidence of motion in an interval of 18 years. The time interval for the photographs available was about the same as for Professor Barnard's visual observations. I therefore decided to postpone further work on photographs until I should have more time for the measurements and reductions. The results as far as obtained are based on the mean of a set of measures on each of the three negatives by Dr. Roberts compared with the measures of one of the best negatives with the 40-inch reflector. The nucleus was measured with reference to twenty-four comparison stars well distributed in position-angle.

These observations as far as they go appear to confirm Professor Barnard's results in showing that the motion must be small. For the

components of the annual motion, in arc of a great circle, the following values resulted from the measures:

R. A. +0″.019
Dec. +0″.002

There is a great difference in the scale of the two instruments—focal lengths 98 inches and 221 inches—and the negatives were made by different observers under probably very different observing conditions. Until we have measured suitable test objects for material of this kind it is difficult to say whether the results are of much value.

PHOTOGRAPHS OF THE VARIABLE NEBULAE N.G.C. 2261 AND N.G.C. 6729.

By C. O. Lampland.

Slides were shown of the photographs, taken with the 40-inch reflector of the Lowell Observatory, of the variable nebulae N.G.C. 2261 and N.G.C. 6729, showing marked changes in the nebulous detail.

In the case of N.G.C. 2261 the changes in the form of the nebula in the interval from the first of March 1916 to the end of January 1917 are very striking. Small changes in parts of the nebulous detail are in some cases perceptible for intervals of only a few days.

The nebula N.G.C. 6729 *Coronae Australis* in some ways resembles N.G.C. 2261 *Monocerotis*. Both are of the cometary form and have irregular variables at the apex. The former of these objects appears to be considerably more active. In some instances there are evidences of change in the detail in negatives taken one or two nights apart.

The variables at the apex of each of these nebulae are no doubt true nuclei. Eventually we may be able to discover some relation between the variability of the nucleus and the changes of form and brightness of the nebulous detail. Practically all of my time in connection with these nebulae has been given to the accumulation of photographs, but I hope before long to make a careful study of the negatives.

RECENT OBSERVATIONS OF NOVA PERSEI 1901.

By C. O. Lampland.

Photographs of the region of *Nova Persei* with the 40-inch reflector of the Lowell Observatory have been made at different times during the present year. The band of nebulosity near it discovered visually by Professor Barnard in December 1916 is well shown on the negatives. The photographs of best quality were taken on February 11, March 13 and August 14. On these the nebulosity appears to have undergone

no very marked change in brightness, form or position. It may be slightly broader on the photograph of August 14 as compared with the negative of February 11 and there may be a slight change in the position angle of the longer axis of the nebulosity. The broadening, if real, appears to have taken place on the side towards the Nova—the edge away from the Nova remaining stationary.

The magnitude of the Nova on February 11 and March 13 is about 12 compared with the stars near by, the visual magnitudes of which have been given by Professor Barnard in his position measurements of the Nova. On the same scale the magnitude on August 14 was about 13.5. Photographs of the region were made on July 27, 30, 31, August 12, 13 and 14. The Nova appears to be considerably brighter on the plates taken in July then those exposed in August about two weeks later.

VARIATION OF LATITUDE AT THE U. S. NAVAL OBSERVATORY.

By F. B. Littell.

Preliminary results of the variation of latitude observations from October 1915 to March 1917, made at the Naval Observatory with the photographic zenith tube devised and formerly used by Dr. Ross at Gaithersburg, Maryland.

A slide was shown giving the plotted values of the observed latitudes for each night when observation was made, for the period October 27, 1915 to June 30, 1917.

The accidental probable error of a single latitude from one star for the last period at Gaithersburg was $\pm 0''.090$ and for the first year at Washington was $\pm 0''.084$. The accidental probable error of a single latitude from a visual pair observed with the zenith telescope at Gaithersburg was, according to Dr. Ross, $\pm 0''.113$.

PHOTOGRAPHY OF THE SOLAR SPECTRUM FROM 6800 Å TO 9600 Å.

By W. F. Meggers.

The red and adjacent infra-red regions of the solar spectrum have never been photographed with results comparable to those obtained in the remainder of the visible and in the ultra-violet regions. During the past year the use of photographic plates stained with dicyanin has enabled the Bureau of Standards to extend the spectra of 32 of the chemical elements to wave lengths in many cases longer than 9000Å. This success with artificial sources suggested an attempt to photograph the infra-red solar spectrum with dicyanin stained plates. The work

was undertaken recently at the Johns Hopkins University with a large plane grating spectrograph giving a linear dispersion of 2Å per mm. Vibrations caused by heavy street and railway traffic made exposures longer than 20 minutes impossible, but these sufficed to record the solar spectrum with good detail out to 9600Å. Between 6800Å and 9600Å these photographs show more than 1700 Fraunhofer lines, 364 of which have now been identified with emission lines in the spectra of 18 of the chemical elements.

Under more favorable conditions these dicyanin stained plates would probably have recorded the solar spectrum out to 10,000Å. Their sensitiveness to the long waves recommends their use for the extension of chromospheric and sunspot spectra also.

THE APPLICATION OF DICYANIN TO STELLAR SPECTROSCOPY.

By Paul W. Merrill

This paper describes the application of photographic plates sensitized to the red and infra-red radiations, by the use of dicyanin, to stellar spectroscopy. The observations were carried out at the Harvard College Observatory using the 24-inch reflecting telescope and objective prism. The brief program was necessarily in the nature of a reconnaissance, but the results indicate the desirability of future observations in the extreme red and infra-red, with both objective prism and slit spectrographs.

Fraunhofer's A band, wave length .760 μ, and a considerable region of greater wave length were photographed in numerous stellar spectra. Several new absorption flutings were discovered in late type spectra, the most striking beginning at .760 μ, nearly coincident with A, and running toward the red. Circumstances indicated that this band might be due to titanium oxide, and experiments since made at the Bureau of Standards have shown a band in this position in the spectrum of the titanium arc.

The greatest wave lengths observed in stellar spectra appear, by extrapolation, to be about .87 μ.

The general conclusions arrived at are as follows:

1. Many stellar spectra possess sufficient intensity in the region of wave length .80 μ to enable this portion of the spectrum to be photographed on plates sensitized with dicyanin.

2. In favorable instances stellar spectra can be well observed to wave length .85 μ.

3. The region of greater wave length than .70 μ contains features of importance, especially in the case of the later spectral types.

The processes employed and the detailed results will be published in a Scientific Paper of the Bureau of Standards.

COMPARISON OF AN EIGHT-INCH VOIGTLÄNDER DOUBLET WITH A NEW TEN-INCH ANASTIGMAT.

By Joel H. Metcalf.

The 10-inch Metcalf triple anastigmat, which has now been in use at the Harvard Observatory for upwards of a year, gives the material for a direct comparison of the relative merits of the old Petzval doublet type of objective of larger relative aperture and a modern flat field triple lens. Harvard Observatory has been using for many years its 8-inch Draper telescope, which is a Voigtländer (Petzval) doublet. As both lenses have approximately the same focal length (45.5 inches) it is possible to make a direct comparison of the size and shape of the star images on different parts of the plate taken with the same plate center and with similar exposures. We thus have ocular demonstration of the comparative merits of these two types of lenses.

Several lantern slides were shown which contained sample star images of both lenses side by side, showing the astigmatism of the 8-inch and its correction in the 10-inch.

An investigation of the field by Miss Henrietta Leavitt of the Harvard Observatory gives the following results:

Quality of field	Triple Anastigmat Metcalf 10-inch	Voigtländer Petzval type Draper 8-inch
	°	°
Good	7.2	3.3
Fair	10.0	4.5

For an average field for charting and searching purposes the Metcalf 10-inch working with a relative aperture of 1 to 4.5 is reasonably good over 15°, which is a little over twice that of the Draper 8-inch. The interesting fact was brought out that a glass of slightly greater aperture could be made with no sacrifice of field.

THE PHOTOGRAPHIC TELESCOPE OF THE U. S. NAVAL OBSERVATORY. FINAL METHODS OF LENS ADJUSTMENT, AND LINES OF RESEARCH PURSUED.

By George Henry Peters.

Two previous papers, read before this society, are referred to, concerning the details of construction and adjustment of a pair of twin 10-inch triple photographic objectives, and their employment in a photographic telescope. The methods of visual collimations and adjustments given in one of these previous papers were found not to be rigorous enough on account of unavoidable observational errors.

After some delay, a photographic method was adopted, using out of focus star images. The errors of adjustment observed in these star discs were corrected by the collimation screws attached to each lens cell, and by the centering adjustment of the middle lens. Differential coefficients were employed in computing the necessary movement of any element to correct observed aberrations, and to secure collimation alignment. These lenses are a type of the Cooke stellar lens. They were computed from Taylor's formula by Mr. E. D. Tillyer, then a member of the Observatory staff. The elements can be removed from their cells for cleaning without disturbing the collimation adjustments.

A preliminary list of asteroids was first observed to test the completed apparatus. The measures proving concordant a rigid program was determined upon. Arrangements were consequently made with Professor Wolf through the courtesy of Professor Cohn of the Rechen Institut for the Naval Observatory to take the four lower degrees of the Heidelberg zones. This gave our observatory the following zones varying with the season:

Declination	$+4^\circ$ to $+8^\circ$	March, April, September and October,
	0° to $+4^\circ$	May to August,
	$+12^\circ$ to $+16^\circ$	November to February.

Any asteroid given in the *Berliner Jahrbuch* ephemerides entering these zones, and which can be photographed with these lenses is supposed to be observed twice near opposition. With few exceptions this has been accomplished. Additional observations are sometimes made on account of the overlapping field of the plates, and for other reasons. The 8-inch by 10-inch plates employed take in a region of the sky 4° in δ and 5° in α at the equator. The results in these observations have been published for several years in the *Astronomical Journal.*

The merits of the coöperative zone system in the observation of asteroids is discussed. The advantages of the division of work among a number of different observatories is also noted.

Plate measurements are performed upon the Stackpole engine of the Naval Observatory. Astronomische Gesellschaft places are used, where possible, for comparison stars. Three stars at least, combined in pairs, with the asteroid between, are always employed. Two or more reductions are then made from these measures. The published places are the means of these reduced results, with the last place of decimals omitted. This gives positions to a second of arc in δ, and to 1/10 second of time in α. The mean places of the comparison stars for the beginning of the year are employed, without the use of the reductions to apparent place. Should apparent places be required, this operation can be subsequently performed on the asteroid position itself, without the introduction of sensible error.

Besides asteroid observations these photographic lenses of 10 inches aperture and 113 inches focal length have been found suitable for determining star positions differentially. They have proven eminently satisfactory in position work and of fine figure, although constructed by a comparative amateur.

Lantern slides were shown of asteroids and their comparison stars illustrating the paper, together with views of the apparatus described.

VARIABILITY OF ASTEROIDS.

By Edward C. Pickering.

A number of the asteroids have been shown to vary in light, by an amount which generally does not exceed half a magnitude. Measures by photometers having very small errors of observation are much to be desired. *Eunomia* (15) was found by Professor Wendell to be variable from 1584 measures from March 15 to May 9, 1905. The instrument used was the photometer with achromatic prisms attached to the Harvard 15-inch telescope. Mr. Leon Campbell has made 5360 settings, with the same instrument, from August 22, 1916 to March 6, 1917, and has discussed both series. The probable error of a set of sixteen settings is ± 0.03 magnitude and the observations extend over 34518 periods of about $0^d.1267$. These observations give excellent light curves, and determine the times of maxima with a probable error of about $\pm 0^d.003$, or four minutes. They show that the direction of rotation is the same as that of the earth, the first time that this has been proved in the case of an asteroid.

THE TOTAL SOLAR ECLIPSE OF 1918, JUNE 8, AS VISIBLE IN THE UNITED STATES.

By William F. Rigge.

Three maps of the United States, referring respectively to the beginning, middle and end of the eclipse, showed the central times of the phases, the position angles of the points of first and last contact as counted from the Sun's north point as well as from its vertex, the path of totality, the magnitude of the eclipse and the Central Times of sunset.

DIRECT APPLICATION OF WULF'S ELECTROMETER FOR RECORDING THE TIME SENT BY WIRELESS TELEGRAPHY, AND ITS CONNECTION WITH THE POTASSIUM PHOTO-ELECTRIC CELL TO REGISTER THE DURATION OF THE TOTALITY IN A SOLAR ECLIPSE.

By Luis Rodés

A new method is explained for recording exactly astronomical phenomena, and the results are presented which were obtained by Professor Wulf in conjunction with the author, during the eclipse of August 21, 1914, in Hernoesand, Sweden. The method is founded on the use of Wulf's electrometer in connection with the potassium photo-electric cell of Elster and Geitel; the latter operating as an electrostatic field capable of reacting in less than one thousandth of a second to the variations of light, and the electrometer affording a most accurate means of registering any changes in the field.

The curve due to the variation of the electrostatic field and consequently to the variation of light under observation is received on the same photographic paper as the oscillations of the pendulum, and that is obtained, not by electric contact, but by having its swing in such a manner as to intercept completely the light every second.

The correction of the pendulum is previously obtained by recording its indications and also those sent by wireless from some astronomical observatory both on the same photographic paper; the accuracy thus obtained permits one to approximate one hundredth of a second without any admission of subjective error.

Some lantern slides were presented, taken from the original pictures in which the results of this method could be fully appreciated.

A PLEA FOR THE SMALL TELESCOPE.

By Harry B. Rumrill.

While hardly anyone nowadays would care to seriously question the dependence of the future of astronomy on the results to be achieved from the use of the great instruments of the world's principal observatories, it appears to the writer that the opinion is still too common that the smaller instruments have had their day. This, too, when even some of the larger telescopes must, to some extent, share the assumed "innocuous desuetude" of the smaller ones because of the gradual absorption of the field of discovery by the photographic telescope and the various developments of the spectroscope. It is even advocated that the only constructive work in which the amateur's equipment may possibly share is that of variable star observation, because it comes within the capacity of moderate optical power.

The writer is not advocating desultory observation, no matter how interesting, but work with a purpose, in the belief that the small telescope should not only not be relegated to any narrow line of observation or even to the broader educational field, but that to a sufficient extent to warrant the constant employment of many instruments of moderate power the field of discovery is not yet closed to the amateur, and that the more our beloved science is pursued by such in the finest spirit of inquiry the greater its future will be.

ON THE MASSES OF THE STARS.

By Henry Norris Russell.

The masses of all those double stars for which sufficient data are available have been determined in the following ways.

1. For visual binaries, for which orbits and direct determinations of parallax were available, by the usual formula.

2. For physical pairs, for which parallaxes, but no orbits were available, by the statistical process first described by the writer.

3. For spectroscopic binaries showing the secondary spectrum, by allowing for the probable inclination of the orbits.

4. For all visual binaries and physical pairs for which good proper motions were available, with the aid of their parallactic motions.

The results for the mean mass of a pair of stars are as follows,—the stars being grouped according to the spectral class of the bright components, and the giant and dwarf stars separated. The sun's mass is the unit.

	Spectroscopic Binaries		Visual Binaries		Physical Pairs		Parallactic Motions	
Spectrum	No.	Mass	No.	Mass	No.	Mass	No.	Mass
B0—B5	13	17.5			8	10.4	36	7.1
B8—A5	18	4.0	6	5.9	12	3.0	114	8.4
F —G, giant	34	3.9					37	8.1
K —M, giant							38	9.8
F —F5, dwarf			17	3.5	9	3.4	60	2.5
F8—K0, "			21	1.8	10	1.4	51	0.7
K5—M "			4	0.7	8	1.0		

The first three groups present quite independent data. The fourth includes stars of the second and third groups, but it is for the most part independent.

The giant stars of all spectral classes are nearly equal in mass, as they are in brightness. On the other hand, among the dwarf stars where the luminosity falls off rapidly with increasing redness, the mean mass falls off too, though much more slowly. It appears therefore that, as a matter of statistical averages, the masses of the stars depend upon their absolute magnitudes, rather than upon their spectral types. The brighter stars are the more massive.

This is in accordance with the theory of evolution proposed four years ago by the writer and recently developed mathematically by Eddington, according to which only the more massive stars can attain great luminosity. The observational preference for the brighter and more distant objects which can not be avoided in lists prepared according to visual magnitude, has probably also operated in the case of the giant stars.

The hypothetical parallax of any binary star or physical system may be determined by means of the equations

$$h = F\frac{a^3}{P^2} \quad \text{or} \quad h = 0.409\ F\ \sqrt[3]{sw^2}$$

where a is the mean distance and P the period, in the case of a binary; s the apparent distance, and w the apparent relative motion, in seconds of arc per year, in the case of a physical pair; and the constant F has the value 0.50 for all giant stars, and is equal to $0.58+0.14$ (Sp.—A) for the dwarf stars,—that is, to 0.58 for spectrum A, 0.72 for F, &c.

Among the dwarf stars, these formulae should predict the parallax of a binary for which a reliable orbit is available with a probable error of about ± 12 per cent of its value, and that of a physical pair showing relative motion with a probable error of about ± 22 per cent.

ON THE DETERMINATION OF THE ORBITS OF VISUAL BINARY STARS.

By Henry Norris Russell.

A satisfactory method of determination must admit of fitting a curve of theoretically possible shape to the whole series of observations at once, and adjusting this to obtain as good a representation as possible before proceeding to the computation of the elements. This may be done if the "interpolating curves" which represent the angle and distance as functions of the time are regarded as the fundamental data. Formulae are given for the rapid computation of the ephemeris and elements in the cases (1) where the orbit is seen edgewise, (2) when it is not.

ORBITS OF VISUAL BINARY STARS.

By Henry Norris Russell.

The following orbits of visual binaries have been computed by the methods just described. The average time required for the computations for one system, including elements, ephemeris, and comparison of observed and computed positions, was five or six hours.

Star	Σ2	OΣ4	β552	Σ1037			Σ1639	*42 Comae*	
a	0".64	0".41	0".58	0".82	1".16	2".00	1".30	0".665	±0".011
e	0.472	0.580	0.520	0.710	0.452	0.582	0.945	0.522	±0.024
γ	± 70°.9	± 26°.2	± 41°.8	± 59°.0	± 70°.5	± 75°.4	± 25°.0	± 89°.87	±0°.09
Ω	166.5	133.6	139.5	131.0	132.8	129.8	145.9	12.6	±0.32
λ	337.1	110.9	313.0	331.3	295.8	251.2	343.5	278.6	±0.8
P	−215.y	−120.y	+ 91.8y	−150.y	−263.y	−510.y	−690.y	+ 25.87y	
T	1890.8	1907.0	1885.9	1921.5	1929.4	1915.8	1891.95	1911.74	±0.08
Sp	A2	F5	F0		F5		F5	F5	
h	0".011	0".013	0".020	0".023	0".022	0".025	0".011	0".061	

The period is given with the positive sign when the apparent motion in angle is direct, and with the negative sign when it is retrograde.

Star	*26 Draconis*		*73 Ophiuchi*	*p Eridani*		*ψ Velorum*
a	1".56	1".37	1".02	5".93	6".94	0".92
e	0.23	0.00	0.550	0.597	0.577	0.407
γ	± 67°.2	± 70°.0	± 77°.2	± 42°.9	± 26°.5	± 54°.7
Ω	153.8	156.9	74.4	5.8	19.5	101.3
λ	294.5	...	35.1	332.5	20.3	210.4
P	−111.y	− 77.8y	−220.y	−242.y	−415.y	+ 37.9y
T	1893.3	1877.3	1913.5	1815.3	1818.9	1901.8
Sp	F		F0	G5		F5
h	0".049	0".054	0".020	0".142	0".116	0".066

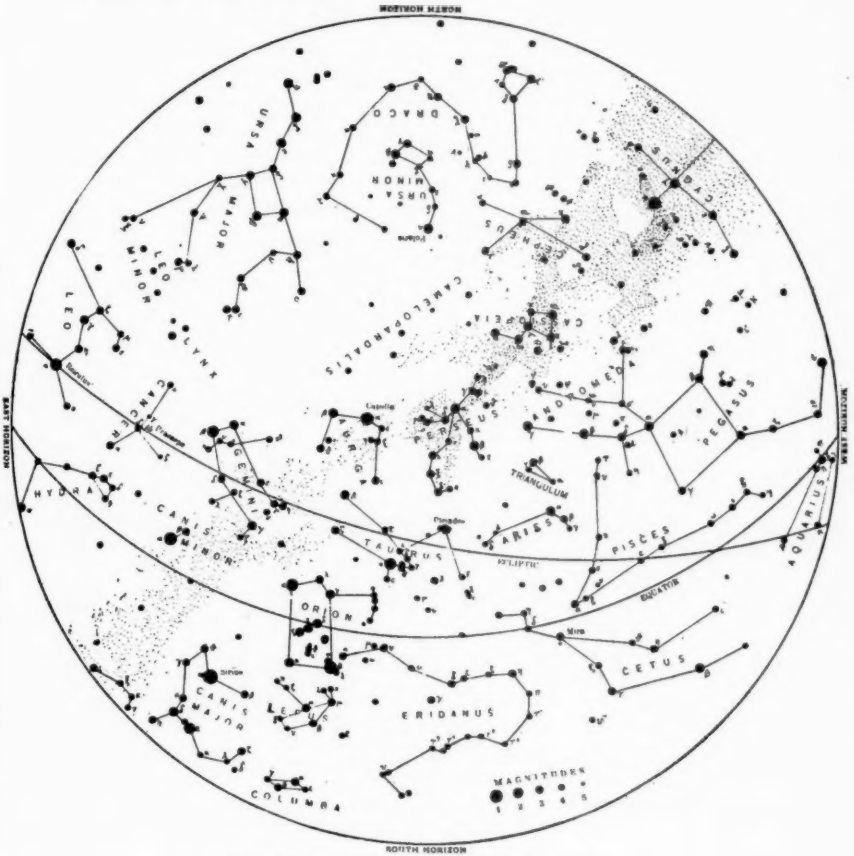
No orbits have previously been computed for Σ1037, *73 Ophiuchi* and *ψ Velorum*. Previous elements of the other systems were in all cases in obvious need of revision. The elements of *42 Comae* are very accurate; those of most of the others are still very uncertain, and all the orbits here given must be regarded as more or less provisional. The alternative orbits given in some cases, (which represent the observations equally well) illustrate the range of uncertainty. The hypothetical parallaxes computed by the formula of the preceding paper are given at the bottom of each column. They show how in most cases the outstanding uncertainty in the elements of the orbit has but little influence on the computed parallax.

p Eridani should be an attractive object for southern parallax observers. Most of the northern stars are much less encouraging.

(*To be continued.*)

PLANET NOTES FOR JANUARY, 1918.

The sun will move in a northeasterly direction from Sagittarius into Capricornus during this month. On the first of January the distance between the earth and the sun will be the least for the year.



THE CONSTELLATIONS AT 9:00 P. M. JANUARY 1.

The phases of the moon for this month are as follows:

Last Quarter	Jan.	5	at 6 A.M.	C.S.T.
New Moon		12	" 5 P.M.	"
First Quarter		19	" 9 A.M.	"
Full Moon		26	" 9 P.M.	"

Mercury, from a position east of the sun at the beginning of the month, will pass the sun on January 2 and continue to move westward until January 15, when it turns and moves eastward again somewhat more slowly than the sun for a time. On January 25 it will be at a point of greatest distance west of the sun, and will then rise about an hour and a half before the sun. At this time it will be about twice as bright as a star of the first magnitude.

Venus will be a most brilliant object in the evening sky during this month. It will have its greatest brilliancy on January 4. At this time less than one-third of the illuminated portion of the disk will be visible but the object will send forth about fifty times as much light as a star of the first magnitude. Venus will be getting near the sun and will set earlier from night to night.

Mars, during this month, will come to the meridian early in the morning. It will therefore be visible only after midnight. It will continue to approach the earth, and, at the middle of the month, will be at a distance from the earth equal to the mean distance from the earth to the sun.

Jupiter will be most favorably situated during the month. It will be on the meridian in the early evening throughout the month. Because of its great brilliancy it will easily be distinguished from the stars in the sky.

Saturn will be coming into better position again. During this month it will be in good position for observation about midnight. It will be in opposition and therefore rise at sunset on January 31.

Uranus will be invisible except during the first few days of the month. The sun will then move so close to it in the sky as to render it invisible for the rest of the month.

Neptune will be on the meridian about midnight. It will be in the constellation Cancer, but not near any conspicuous star.

Occultations Visible at Washington.

[*From the American Ephemeris.*]

Date 1918	Star's Name	Magnitude	IMMERSION. Washington M.T.		Angle f'm N.	EMERSION. Washington M.T.		Angle f'm N.	Duration	
			h	m	°	h	m	°	h	m
Jan. 5	75 Virginis	5.6	16	2	97	17	18	326	1	16
6	231 G Virginis	6.4	13	16	100	14	14	308	0	58
6	236 G Virginis	5.7	14	4	92	15	3	318	0	59
7	64 G Librae	5.8	17	14	118	18	33	286	1	19
8	41 G Scorpii	6.3	17	57	116	19	13	274	1	16
19	20 H^1 Arietis	6.4	8	54	119	9	45	208	0	51
20	ζ Arietis	5.0	13	22	101	14	14	250	0	52
21	161 B Tauri	6.5	7	23	32	8	23	305	1	0
22	99 Tauri	6.0	6	22	72	7	43	273	1	21
23	1 Geminorum	4.3	12	6	91	13	20	297	1	14
23	3 Geminorum	5.6	15	20	32	15	38	357	0	17
23	6 Geminorum	6.3	16	20	54	16	55	331	0	35
24	*d* Geminorum	5.2	7	1	105	8	20	268	1	19
25	3 Cancri	5.7	17	45	138	18	33	264	0	48
26	90 B Cancri	6.3	8	5	104	9	22	293	1	17
27	*h* Leonis	5.2	14	58	149	16	9	276	1	11
29	p^5 Leonis	6.1	16	37	91	17	44	333	1	7

Jupiter's Eighth Satellite.—In the October number of *The Observatory* "J. J." states that "Throughout the closing months of the present year this satellite will be more than three degrees distant from the planet. The opposition takes place on November 28 in about 20° N. declination. The circumstances are therefore extremely favorable for observation. It is important to secure as many obser-

vations as possible, so that the distance of the satellite from the planet may be accurately determined. This will lead to an accurate determination of Jupiter's mass." The following ephemeris is given:

Satellite—Jupiter.

		R. A.	Dec.
		m s	° ′
1917	Sept. 9	−9 50	−1 16
	29	−11 06	−1 18
	Oct. 19	−12 10	−1 19
	Nov. 8	−12 56	−1 20
	28	−13 17	−1 20
	Dec. 18	−13 10	−1 16
1918	Jan. 7	−12 39	−1 09
	27	−11 56	−0 59

Phenomena of Jupiter's Satellites.

VISIBLE AT WASHINGTON.

[*From the American Ephemeris.*]

CENTRAL STANDARD TIME.

1917	h	m		
Jan. 1	6	16	I	Oc. D.
	8	17	I	Ec. R.
2	4	39	I	Tr. E.
	5	29	I	Sh. E.
	5	54	III	Tr. I.
	7	29	II	Ec. R.
	7	50	III	Tr. E.
	9	11	III	Sh. I.
	11	20	III	Sh. E.
6	12	37	I	Oc. D.
7	9	50	I	Tr. I.
	10	45	I	Sh. I.
	11	13	II	Tr. I.
	12	0	I	Tr. E.
	12	55	I	Sh. E.
	13	6	II	Sh. I.
	13	43	II	Tr. E.
8	7	4	I	Oc. D.
	10	13	I	Ec. R.
9	5	14	I	Sh. I.
	5	40	II	Oc. D.
	6	26	I	Tr. E.
	7	24	I	Sh. E.
	9	22	III	Tr. I.
	10	5	II	Ec. R.
	11	21	III	Tr. E.
	13	11	III	Sh. I.
10	4	42	I	Ec. R.
11	4	56	II	Sh. E.
13	5	15	III	Ec. R.
14	11	38	I	Tr. I.
	12	39	I	Sh. I.
	13	36	II	Tr. I.
	13	48	I	Tr. E.
15	8	53	I	Oc. D.
	12	8	I	Ec. R.
16	6	6	I	Tr. I.

1917	h	m		
Jan. 16	7	9	I	Sh. I.
	8	2	II	Oc. D.
	8	15	I	Tr. E.
	9	19	I	Sh. E.
	12	40	II	Ec. R.
	12	55	III	Tr. I.
17	6	37	I	Ec. R.
18	5	3	II	Sh. I.
	5	20	II	Tr. E.
	7	34	II	Sh. E.
20	7	4	III	Ec. D.
	9	18	III	Ec. R.
21	13	28	I	Tr. I.
22	10	43	I	Oc. D.
23	7	55	I	Tr. I.
	9	4	I	Sh. I.
	10	5	I	Tr. E.
	10	27	II	Oc. D.
	11	14	I	Sh. E.
24	5	10	I	Oc. D.
	8	33	I	Ec. R.
25	5	17	II	Tr. I.
	5	43	I	Sh. E.
	7	41	II	Sh. I.
	7	49	II	Tr. E.
	10	13	II	Sh. E.
27	6	15	III	Oc. D.
	8	22	III	Oc. R.
	11	5	III	Ec. D.
29	12	34	I	Oc. D.
30	9	46	I	Tr. I.
	10	59	I	Sh. I.
	11	56	I	Tr. E.
	12	54	II	Oc. D.
31	7	2	I	Oc. D.
	10	29	I	Ec. R.

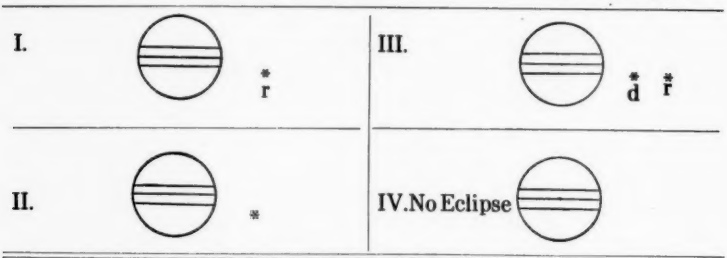
Note:—I., denotes ingress; E., egress; D., disappearance; R., reappearance; Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow.

Satellites of Jupiter, 1918.

GREENWICH MEAN TIME.

JANUARY

Phases of the Eclipses of the Satellites for an Inverting Telescope.



Configurations at 15h 30m for an Inverting Telescope.

Day	West	East
1	·2 ○ 4 1 3·	
2	4· 1· 3· ○ ·2	
3	4· 3· ○ 1 2	
4	4· ·3 2··1 ○	
5	4· 2 3 ○ .1	
6	·4 ·1 ○ ·3·2	
7	·4 1 ○ ·2 ·3	
8	:.4 2· ○ 3·	·1●
9	○3. 4 1 ○	·2●
10	3· ○ 1 4 2.	
11	·2 2 1 ○ ·4	
12	3 ·2 ○ 1· ·4	
13	·1 ○ .3 ·2 ·4	
14	○ 2 1 ·3 4·	
15	2· ○ 3. ·4	·1●
16	1· ○ ·3 4·	·2●
17	3· ○ ·1 4 2	
18	·3 1·2·4· ○	
19	4· ·3·2 ○ 1·	
20	4· ·1 ○ ·3 ·2	
21	4· ○ 1 2 .3	
22	4· 2· ·1 ○ 3·	
23	○1. ·4 ○ 2 3·	
24	·4 3· ○ ·1 2·	
25	3· ·4 1·2· ○	
26	·3·2 ·4 ○ ·1	
27	·1 ○ ·3 ·2·4	
28	○ 1·2· .3 ·4	
29	2· .1 ○ 3· 4·	
30	·2 1 ○ 3· 4·	
31	3. ○ ·2 .4	.1●

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard 6^h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 January
	h m	° ′		d h	d h d h d h d h d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8	7 11
RT Sculptor.	31.5	−26 13	9.6—10.5	0 12.3	7 20; 15 12; 23 4; 30 20
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	2 3; 9 13; 24 10; 31 20
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	2 4; 9 16; 17 3; 24 15
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	2 22; 9 0; 21 6; 27 9
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	3 14; 10 17; 17 21; 25 0
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	6 11; 13 8; 20 5; 27 1
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	2 4; 9 8; 23 17; 30 21
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	4 18; 13 13; 22 8; 31 2
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	8 2; 16 1; 23 23; 31 22
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6	21 5
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	5 3; 10 20; 22 8; 28 1
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	6 0; 12 19; 19 14; 26 9
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	7 17; 15 14; 23 12; 31 10
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	1 10; 9 18; 18 1; 26 8
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	3 17; 11 14; 19 12; 27 9
RW Persei	13.3	+42 04	8.8—11.0	15 04.8	7 23 21 4
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	4 15; 14 1; 23 12
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	5 6; 17 16; 30 2
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	4 2; 10 18; 24 2; 30 18
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	6 1; 14 6; 22 10; 30 14
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	4 23; 10 23; 23 0; 29 1
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	1 16; 10 8; 19 0; 27 16
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	1 8; 11 18; 22 4
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	1 14; 9 14; 17 15; 25 15
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	1 3; 6 21; 18 8; 29 19
U Columbae	6 11.2	−33 03	9.2—10.0	2 19.2	4 6; 9 20; 21 1; 26 15
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	1 15; 9 20; 18 0; 26 5
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	5 13; 13 4; 20 19; 28 10
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	1 21; 14 2; 26 7
RU Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	7 12; 14 17; 21 21; 29 1
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	5 0; 11 19; 18 15; 25 10
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	2 0; 11 8; 20 15; 29 22
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	1 6; 7 20; 21 2; 27 16
TX Gemin.	30.3	+17 8	10.0—11.9	2 19.2	1 15; 10 0; 18 10; 26 20
RR Puppis	43.5	−41 08	9.4—10.7	6 10.3	5 22; 12 8; 25 4; 31 15
V Puppis	7 55.4	−48 58	4.1— 4.8	1 10.9	1 11; 8 17; 23 6; 30 13
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	4 3; 12 6; 20 9; 28 12
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	7 4; 16 15; 26 3
RX Hydrae	9 00.8	− 7 52	9.1—10.5	2 6.8	5 5; 12 2; 18 22; 25 18
S Velorum	29.4	−44 46	7.8— 9.3	5 22.4	1 13; 13 10; 25 7; 31 5
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	1 13; 8 6; 21 18; 28 12
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	3 0; 10 10; 17 20; 25 6
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	6 10; 13 0; 19 15; 26 5
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	5 10; 14 5; 23 0; 31 19
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	2 6; 9 14; 24 6; 31 13
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	4 22; 11 17; 18 12; 25 7
RZ Centauri	12 55.6	− 64 05	8.5— 8.9	1 21.0	3 2; 10 14; 18 2; 25 14
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.2	8 8; 17 22; 27 13
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	4 6; 11 16; 19 3; 26 13
δ Librae	14 55.6	− 8 07	4.8— 6.2	2 07.9	1 13; 8 13; 22 12; 29 12

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1918 January							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	7 19;	14 17;	21 14;	28 12				
TW Draconis	32.4	+64 14	7.3— 8.9	2 9.12	6 18;	15 4;	23 14					
SS Librae	15 43.4	—15 14	9.3—11.5	0 18.4	5 2;	12 17;	20 9;	28 1				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	3 18;	11 2;	18 11;	25 19				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	3 11;	11 17;	19 23;	28 5				
R Arae	31.1	—56 48	6.8— 7.9	4 10.2	7 0;	15 20;	24 17					
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	4 11;	15 13;	25 6;	5 7				
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	3 8;	10 3;	23 18;	30 13				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	7 3;	15 12;	23 22					
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	4 8;	10 12;	22 19;	28 23				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	4 19;	12 0;	19 5;	26 10				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	6 18;	14 3;	21 12;	28 21				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	1 19;	9 23;	18 4;	26 8				
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	6 13;	14 2;	21 15;	29 4				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	3 5;	10 23;	18 17;	26 11				
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	8 22;	16 21;	24 21					
WX Sagittae	53.6	—17 24	9.2—10.8	2 03.1	6 3;	14 16;	23 4;	31 17				
WY Sagittae	17 54.9	—23 1	9.5—10.6	4 16.0	6 20;	16 4;	25 12					
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	4 19;	15 3;	25 12					
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	7 1;	14 7;	21 13;	28 19				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	5 11;	12 9;	19 7;	26 4				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2		12 14;		27 17				
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	7 0;	14 4;	21 8;	28 12				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	5 0;	12 3;	19 6;	26 9				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	1 11;	9 18;	18 2;	26 9				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	2 1;	10 13;	19 0;	27 12				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	2 3;	8 18;	15 9;	22 1				
β Lyrae	46.4	+33 15	3.4— 4.1	12 21.8		11 14;	24 12					
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	5 5;	12 20;	20 12;	28 3				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	1 11;	9 1;	24 4;	31 18				
RV Lyrae	12.5	+32 15	11. —12.8	3 14.4	9 19;	16 23;	24 4;	31 8				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	6 6;	15 5;	24 4					
U Sagittae	14.4	+19 26	6.5— 9.0	3 09.1	5 14;	12 8;	19 2;	25 20				
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	7 23;	15 8;	22 16;	30 1				
TT Lyrae	24.3	+41 30	9.3—11.6	5 05.8	5 20;	11 2;	21 14;	26 20				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	4 0;	10 12;	23 13;	30 2				
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	6 3;	12 3;	24 4;	30 4				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	2 6;	8 21;	22 4;	28 19				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	2 3;	11 7;	20 10;	29 14				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	6 17;	15 3;	23 14					
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	3 12;	10 7;	23 20;	30 15				
UW Cygni	19.6	+42 55	10.5—10.8	3 10.8	7 21;	14 19;	21 17;	28 14				
V Vulpec.	32.3	+26 15	8.2—9.8	37 19.0								
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	6 20;	16 11;	26 2					
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	6 16;	15 21;	25 2					
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	4 7;	11 19;	19 6;	26 18				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	1 23;	9 13;	17 3;	24 17				
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	6 10;	16 12;	26 15					
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	4 8;	11 17;	19 3;	26 12				
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	3 2;	12 19;	22 12					
RY Aquarii	14.8	—11 14	8.8—10.4	1 23.2	3 9;	11 5;	19 2;	26 23				
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	1 13;	11 17;	21 20					
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3	3 14							
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	3 5;	8 10;	18 18;	23 23				
TT Androm.	23 08.7	+45 36	11.3—12.6	2 18.3	1 11;	9 18;	18 1;	26 8				
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	3 19;	11 8;	18 21;	26 10				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	3 3;	11 8;	19 14;	27 20				

Maxima of Variable Stars of Short Period.

[Calculated by Julia M. Hawkes at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h; etc.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. January							
	h m	° ′		d h	d h	d h	d h	d h				
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7		11 10						
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	4 22;	13 2;	21 5;	29 8				
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	2 1;	9 19;	17 12;	25 6				
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2		12 2;		26 22				
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	5 21;	13 19;	21 18;	29 17				
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	8 9;	16 4;	23 23;	31 19				
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	7 15;	14 22;	22 4;	29 11				
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	7			23				
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	1 1:	9 15;	18 5;	26 18				
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1		9 11;	20 14;	31 18				
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0		11 19;	23 10					
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	4 5;	11 21;	19 13;	27 5				
SY Aurigae	05.5	+42 41	8.4— 9.5	10 03.3		10 9;	20 12;	30 15				
Y Aurigae	21.5	+42 21	8.6— 9.6	3 20.6	1 1;	8 18;	16 12;	24 5				
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	3 19;	14 20;	25 22;	31 11				
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	2 8;	9 22;	17 11;	25 1				
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3		6 1						
RT Aurigae	23.0	+30 33	5.1— 6.0	3 17.5	8 9;	15 20;	23 7;	30 18				
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	6 15;	13 20;	21 1;	28 6				
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	7 22;	15 20;	23 18;	31 16				
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	2 14;	12 17;	22 21					
RU Camelop.	7 10.9	+69 51	8.5— 9.8	12 06.5		12 8						
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	4 16;	12 15;	20 13;	28 12				
V Carinae	8 26.7	−59 47	7.4— 8.1	6 16.7	7 8;	14 1;	20 18;	27 11				
T Velorum	8 34.4	−47 01	7.6— 8.5	4 15.3	7 4;	16 11;	25 17					
V Velorum	9 19.2	−55 32	7.5— 8.2	4 08.9	1 12;	10 5;	18 23;	27 17				
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	2 19;	9 14;	23 4;	29 23				
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	5 3;	11 18;	24 23;	31 13				
S Muscae	12 07.4	−69 36	6.4— 7.3	9 15.8	1 23;	11 14;	21 6;	30 22				
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	1 17;	9 17;	17 16;	25 16				
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	4 23;	11 16;	25 3;	31 21				
R Crucis	18.1	−61 04	6.8— 7.9	5 19.8	3 20;	9 15;	21 7;	27 3				
S Crucis	12 48.4	−57 53	6.5— 7.6	4 16.6	3 11;	12 20;	22 5;	31 14				
W Virginis	13 20.9	− 2 52	8.7—10.4	17 06.5		8 21		26 3				
SS Hydrae	25.0	−23 08	7.4— 8.1	8 4.8	7 19;	16 0;	24 5					
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	2 13;	9 14;	23 14;	30 15				
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	6 2;	14 7;	22 12;	30 17				
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	2 6;	13 6;	24 6;	29 18				
RS Bootis	29.3	+32 11	8.6—10.0	0 09.1	7 3;	14 16;	22 5;	29 19				
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	8 0;	15 9;	22 19;	30 5				
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	2 22;	9 17;	23 6;	30 1				
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	5 10;	11 18;	24 10;	30 17				
S Normae	16 10.6	−57 39	6.6— 7.6	9 18.1		8 15;	18 9;	28 3				
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	3 11;	12 8;	21 5;	30 1				
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	3 11;	9 13;	21 16;	27 17				
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	3 1;	10 1;	24 1;	31 2				
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9		9 6;		26 9				
W Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	6 12;	14 3;	21 17;	29 7				
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	6 16;	12 10;	23 23;	29 18				
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	4 20;	11 14;	25 2;	31 20				
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3		10 14;	20 22;	31 7				
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	5 12;	11 13;	23 15;	29 16				
RZ Lyrae	39.9	+32 42	9.9—11.2	0 12.3	3 15;	9 19;	22 1;	28 4				
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	1 2;	12 23;	24 21;	30 20				
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	8 14;	17 16;	26 18					

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1918. January							
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	4 5;	11 5;	18 6;	25 6				
XZ Cygni	30.4	+56 10	8.6— 9.3	0 11.2	2 1;	9 1;	23 1;	30 1				
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	3 18;	11 18;	19 17;	27 17				
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	7 18;	15 11;	23 4;	30 21				
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	7 17;	14 21;	22 2;	29 6				
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	3 14;	11 23;	20 8;	28 17				
X Vulpec.	19 53.3	+26 17	9.51—0.5	6 07.7	2 17;	9 1;	21 16;	27 23				
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3			17 8					
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	4 19;	13 15;	22 12;	31 9				
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	5 11;	12 4;	18 21;	25 15				
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	3 8;	10 1;	23 11;	30 4				
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4		13 23		28 17				
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	3 8;	11 5;	19 2;	26 22				
SW Aquarii	10.2	− 0 20	9.9—10.8	0 11.0	7 17;	14 14;	21 12;	28 9				
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	5 13;	10 10;	20 3;	29 21				
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	1 3;	9 19;	18 10;	27 2				
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	3 12;	12 5;	24 23;	30 8				
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	4 0;	14 21;	25 18					
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	4 12;	10 23;	17 9;	30 5				
V Lacertae	22 44.5	+55 48	8.5— 9.5	4 23.6	1 7;	11 6;	21 5;	31 5				
X Lacertae	45.0	+55 54	8.2— 8.6	5 10.7	2 5;	7 16;	18 13;	29 11				
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	1 11;	12 8;	23 5;	28 15				
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	1 13;	7 20;	20 10;	26 17				
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4		10 15;	22 18					
V Cephei	23 51.7	+82 38	6.0—7.0	0 23.6	5 22;	15 22;	25 21;	30 21				

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, October-November, 1917.

We continue to break our record for the number of observations made by our members during the month. This report containing, as it does, 2600 observations contributed by twenty-eight observers well attests the interest that is being taken in this important branch of astrophysical research and the zeal of our active members.

We have, also, exceeded this month the number of variables heretofore observed in any one month by our observers. The record shows that 269 stars were observed, a good indication of the desire on the part of our observers to increase the efficiency of our service. Many observers are observing faint and heretofore neglected stars and an increased number of minima are being constantly observed, all of which makes for progress. Mr. Campbell writes that "over 2700 observations were made at and contributed to the Observatory during the past month, the best record I can recall for a single month."

It is a pleasure to record that on the eve of our meeting at Cambridge to formally organize and elect officers we have enrolled as Charter Members 81 observers including eight Life Members.

The thanks of the Association are due Messrs. Luyten and Vogelenzang, our members in Holland, for their splendid support. Mr. Luyten's list this month contained 712 observations, a record which speaks well for the interest and energy of the observer.

VARIABLE STAR OBSERVATIONS Oct.-Nov., 1917.

October 0 = 2421502 November 0 = 2421533 December 0 = 2421563

001032

S Sculptoris

J.D.	Est.	Obs.
242		
1490.4	<10.5	L
1508.6	11.9	Ba
17.6	11.5	Ba

001046

X Androm.

1508.6	<13.5	Ba
16.6	<12.8	Bu

001620

T Ceti

1430.6	6.5	Lt
48.6	6.7	Lt
51.6	6.7	Lt
57.5	6.7	Lt
61.5	6.7	Lt
64.5	6.4	Lt
65.6	6.4	Lt
66.5	6.3	Lt
88.6	5.9	L
97.6	5.8	L

001726

T Androm.

1508.6	<13.7	Ba
13.7	<10.7	Bg
16.6	<10.7	Bu

001755

T Cassiop.

1456.4	8.8	Lt
57.5	8.7	Lt
63.4	8.8	Lt
69.4	8.8	Lt
1501.5	8.5	B
07.8	8.9	M
08.6	8.7	Bu
08.6	8.8	O
08.6	8.0	Ba
09.5	7.9	D
09.7	9.9	Bg
17.5	8.6	Ba
22.5	8.6	B

001838

R Androm.

1442.4	7.5	Lt
46.4	7.5	Lt
48.4	7.5	Vo
51.4	7.5	Vo
51.4	7.5	Lt
56.4	7.4	Vo
56.4	7.6	Lt
57.4	7.6	Vo
57.5	7.5	Lt
58.4	7.6	Vo
58.5	7.7	Lt
59.4	7.7	Vo
60.4	7.7	Lt
60.4	7.7	Vo

R Androm.

J.D.	Est.	Obs.
242		
1461.4	7.9	Lt
62.4	7.8	Vo
62.5	8.0	Lt
63.4	7.8	Vo
64.4	7.8	Vo
64.4	8.0	Lt
65.4	7.7	Vo
65.5	8.1	Lt
68.4	7.9	Vo
72.4	8.1	Lt
79.3	8.6	Pe
80.3	8.7	Pe
81.3	8.8	Pe
82.3	8.7	Pe
87.3	8.9	Pe
91.3	9.0	Pe
95.2	9.1	Pe
97.3	9.1	Pe
1504.6	8.8	B
07.8	9.3	M
08.6	9.0	Ba
08.6	9.4	O
08.6	8.7	Hu
08.6	9.4	De
15.6	9.1	V
16.6	9.8	Bu
17.5	9.1	Ba

001909

S Ceti

1442.6	9.3	Lt
48.6	8.7	Lt
51.5	8.6	Lt
57.6	8.5	Lt
58.5	8.5	Lt
61.5	8.5	Lt
64.5	8.5	Lt
65.6	8.5	Lt
66.5	8.5	Lt
72.4	8.6	Lt
1509.6	9.3	D
17.5	10.2	Ba
19.9	10.4	Bg
22.7	10.1	De
23.7	10.4	M

003179

Y Cephei

1515.6	10.3	Hu
15.6	9.9	Wh
17.5	10.3	Ba
18.9	10.0	M
20.7	10.4	Ba
22.6	10.4	De

004047

U Cassiop.

1457.5	13.0?	Lt
58.5	13.0?	Lt

U Cassiop.

J.D.	Est.	Obs.
242		
1508.6	<12.2	Bu
15.6	<13.5	B
16.6	<11.7	Wh
17.5	<13.0	Ba
18.5	<12.5	Pi

004181

RX Cephei

1453.5	7.5	Lt
57.4	7.5	Lt
61.5	7.5	Lt
63.4	7.5	Lt
65.5	7.5	Lt

004132

RW Androm.

1508.6	<11.5	Bu
15.6	<13.6	B
17.6	12.2	Ba
37.5	10.3	O

004435

V Androm.

1508.6	<12.0	Bu
15.6	13.7	B
17.6	13.6	Ba

004533

RR Androm.

1451.5	9.4	Lt
58.5	9.4	Lt
64.4	9.5	Lt
65.4	9.6	Lt
72.4	9.8	Lt
1508.6	11.3	Bu
09.6	11.6	De
17.6	11.8	Ba

004746

RV Cassiop.

1508.6	11.7	Bu
16.6	10.6	Wh
17.6	12.0	Ba

004958

W Cassiop.

1441.5	9.2	Lt
51.5	9.2	Lt
57.5	9.2	Lt
61.5	9.2	Lt
66.4	9.2	Lt
1504.6	9.1	O
08.6	9.5	O
08.6	9.5	Bu
15.6	9.3	Hu
16.6	9.7	O
16.6	9.6	Wh
17.6	8.8	Ba
18.7	9.6	Pi
18.9	9.3	M

W Cassiop.

J.D.	Est.	Obs.
242		
1522.6	9.7	O
22.6	9.3	De
29.5	9.0	B
37.5	10.0	O

010102

Z Ceti

1457.6	10.5	Lt
61.5	10.3	Lt
65.6	9.9	Lt
94.8	9.0	By
1500.8	8.9	By
17.6	9.0	Ba

010940

U Androm.

1508.6	10.0	Bu
17.6	9.7	Ba
20.6	10.0	Bg
22.6	9.9	De

011208

S Piscium

1515.6	<11.6	V
17.6	<13.8	Ba

011272

S Cassiop.

1515.6	<13.0	B
16.6	<11.5	Wh
17.6	<13.0	Ba
19.6	<12.0	Bg
22.6	<12.6	De

*012233*a

R Sculptoris

1489.6	6.5	L

012350

RZ Persei

1517.6	13.2	Ba

012502

R Piscium

1508.7	9.5	De
17.6	9.7	Ba
18.7	9.9	Pi

013238

RU Androm.

1505.6	10.4	Bu
17.6	10.8	Ba

013338

Y Androm.

1442.5	9.7	Lt
51.4	9.6	Lt
61.4	9.6	Lt
65.6	9.6	Lt
66.4	9.7	Lt
1505.6	<11.4	Bu
17.6	13.2	Ba
20.7	<11.4	Bg

014958

X Cassiop.

J.D.	Est.	Obs.
242		
1421.5	10.8	Lt
25.5	10.9	Lt
57.5	11.1	Lt
62.4	11.2	Lt
66.4	11.2	Lt
1509.5	12.2	De
15.6	11.6	Y
17.6	11.3	Ba
18.9	10.1	M
22.5	10.7	B

015354

U Persei

1448.4	8.4	Vo
51.4	8.3	Vo
51.5	8.4	Lt
53.4	8.2	Vo
56.4	8.0	Vo
57.6	8.3	Lt
58.4	8.1	Vo
58.5	8.3	Lt
59.4	8.0	Vo
61.4	8.1	Vo
61.4	8.2	Lt
63.4	8.0	Vo
65.6	8.2	Lt
66.4	8.0	Vo
66.4	8.0	Lt
69.4	8.0	Vo
1508.5	8.4	D
08.6	8.5	Bu
09.6	8.2	De
15.6	7.9	Hu
16.6	8.3	Wh
17.6	8.0	Ba
17.7	8.8	V
18.9	8.2	M
19.9	8.0	Bg

015912

S Arietis

1508.6	<11.6	Bu
15.6	12.2	De
16.6	12.5	B
17.6	11.9	Ba
20.6	<11.6	Bg

021024

R Arietis

1457.5	11.0	Lt
58.5	11.0	Lt
61.5	11.0	Lt
63.4	11.0	Lt
65.4	10.8	Lt
72.4	10.2	Lt
79.4	9.3	Pe
81.3	9.3	Pe
91.4	9.3	Pe
97.4	9.3	Pe
1507.7	8.6	M

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

R Arietis

J.D. 242	Est.	Obs.
17.6	9.0	Ba
18.6	9.2	Bu
20.1	9.7	Bg
22.6	9.6	Hu
22.8	9.6	By
37.5	9.5	O

021143a
W Androm.

1456.5	11.2	Lt
65.4	11.7	Lt
1516.6	<11.9	Wh
17.6	12.7	Ba

021281
Z Cephei

1517.7	<11.5	V

021403
o Ceti

1442.5	8.2	Lt
48.5	7.7	Lt
51.5	7.7	Lt
57.5	7.1	Lt
58.5	7.1	Lt
58.5	7.6	Vo
61.5	7.0	Lt
61.5	7.4	Vo
62.5	6.9	Lt
64.5	6.8	Lt
65.6	6.7	Lt
66.5	6.5	Lt
69.4	6.2	Lt
69.6	6.5	Vo
71.6	5.7	Vo
81.4	4.8	Pe
82.4	4.8	Pe
85.4	4.5	Pe
87.4	3.9	Pe
87.6	3.6	L
88.3	3.8	Pe
88.6	3.4	L
89.6	3.4	L
90.4	3.8	Pe
90.4	3.5	L
93.4	3.7	Pe
94.3	3.7	Pe
95.4	3.7	Pe
96.3	3.7	Pe
97.3	3.7	Pe
97.6	3.4	L
98.3	3.7	Pe
1508.6	3.4	Ba
08.8	3.8	By
08.7	3.7	De
13.3	3.5	L
13.6	3.5	Ba
14.6	3.7	De

o Ceti

J.D. 242	Est.	Obs.
1515.6	3.8	Nt
15.6	4.0	Hu
15.8	3.2	By
16.7	3.5	Ba
20.7	3.5	Ba
20.8	3.6	Mu
21.8	3.6	Mu
22.6	3.5	Ba
22.7	3.5	Mu
22.8	3.7	By
23.7	3.6	Mu
24.6	3.4	Mu
24.6	3.8	Rd
30.6	3.6	Ba
32.6	3.7	Ba
38.6	3.9	O

021456
SU Persei

1448.4	8.0	Vo
50.4	8.0	Vo
53.4	8.0	Vo
56.4	8.0	Vo
57.4	8.1	Vo
58.4	8.1	Vo
59.4	8.2	Vo
60.4	8.2	Vo
61.4	8.2	Vo
64.4	8.1	Vo
69.4	8.2	Vo

021558
S Persei

1506.6	9.3	B
17.6	9.1	Ba
20.1	9.2	Bg
30.6	8.9	Ba

022000
R Ceti

1520.7	8.5	Ba

022150
RR Persei

1458.5	13.0?	Lt
62.5	12.7?	Lt
1516.6	9.6	Y
18.6	9.7	Bu
19.5	8.9	Ba

022813
U Ceti

1515.6	7.1	Hu
20.7	8.3	Ba
20.9	8.7	Bg

023133
R Trianguli

1448.5	8.1	Vo
51.4	7.7	Vo
53.4	7.4	Vo

R Trianguli

J.D. 242	Est.	Obs.
57.4	6.7	Vo
58.4	6.7	Vo
59.4	6.4	Vo
61.4	6.4	Vo
63.4	6.2	Vo
66.4	6.2	Vo
71.6	6.3	Vo
1502.7	6.5	Wh
06.6	6.5	B
08.5	6.9	Ba
13.	7.6	ϒ
13.5	7.5	D
14.	7.4	ϒ
15.6	7.0	Hu
15.8	7.2	M
16.	7.4	ϒ
18.6	7.6	Re
18.6	7.8	Bu
19.5	7.7	D
19.6	7.0	Ba
22.7	7.5	De
30.6	7.8	Ba
37.5	8.7	O

024217
T Arietis

1457.5	9.4	Lt
65.6	9.6	Lt
97.7	9.6	L

024356
W Persei

1508.6	9.0	Bu
15.6	9.0	Hu
15.9	9.2	M
16.6	8.8	Wh
18.6	9.0	Bu
18.6	9.0	Re
19.6	8.5	Ba
21.1	9.1	Bg
23.6	9.0	M
30.6	8.7	Ba

025840
β Persei

1475.3	3.1	Hd
76.3	3.1	Hd
86.3	2.8	Hd
93.3	2.9	Hd
94.3	2.2	Hd

030514
U Arietis

1518.6	<12.2	Bu
20.7	<14.5	Ba

031401
X Ceti

1518.6	9.5	Bu
20.7	9.1	Ba

032043
Y Persei

J.D. 242	Est.	Obs.
1458.4	9.4	Vo
61.4	9.4	Vo
66.4	9.5	Vo
1506.6	8.5	B
09.6	8.3	De
15.6	8.0	Hu
15.8	8.7	M
18.6	9.5	Bu
20.7	9.0	Ba
30.6	8.7	Ba

032335
R Persei

1442.5	9.0	Lt
48.5	9.4	Lt
56.5	9.7	Lt
57.5	9.8	Lt
58.5	10.0	Lt
61.4	10.5	Lt
65.6	10.8	Lt
1509.6	<11.5	De
18.6	<11.5	Bu
20.7	12.8	Ba

033362
U Camelop.

1447.4	8.0	Lt
51.5	8.1	Lt
57.5	8.3	Lt
61.5	8.6	Lt
63.4	8.7	Lt
65.5	8.8	Lt
69.4	8.8	Lt
72.4	8.6	Lt
1502.6	7.5	Wh
15.5	8.5	De
18.6	8.5	Bu
20.7	7.0	Ba
30.6	7.1	Ba

035124
T Eridani

1520.7	<12.2	Ba

035915
V Eridani

1520.7	8.4	Ba
20.9	8.9	Bg

041619
T Tauri

1508.6	10.1	Ba
11.8	10.2	M
20.7	9.7	Ba

042209
R Tauri

1508.6	<13.0	Ba
08.7	<10.6	De
11.8	<12.0	M
15.7	11.3	Wh
20.7	<13.3	Ba

042309
S Tauri

J.D. 242	Est.	Obs.
1508.6	<13.0	Ba
08.7	<10.6	De
11.8	<12.0	M
15.7	11.3	Wh
20.7	<13.3	Ba
24.6	<11.7	Re
24.6	<11.7	Bu

042215
W Tauri

1495.4	9.1	Pe
1502.7	9.8	Wh
04.6	9.9	Bu
08.6	9.3	Ba
08.7	10.0	De
09.7	10.3	Pi
11.8	9.8	M
14.6	9.7	Ba
17.6	9.8	Ba
20.7	9.9	Ba
22.8	10.5	M
24.6	10.4	Re
24.6	10.6	Bu
30.6	9.9	Ba
32.6	10.4	Ba

043065
T Camelop.

1457.5	10.1	Lt
66.5	10.8	Lt
1515.8	<11.0	M
20.7	13.0	Ba
30.6	<11.0	Wh

043274
X Camelop.

1451.5	13.0	Lt
56.5	13.0	Lt
58.5	13.0	Lt
62.4	12.8	Lt
64.4	12.9	Lt
65.4	12.8	Lt
1508.5	8.0	Ba
08.6	8.2	O
14.5	8.2	Ba
15.8	8.5	M
16.6	8.2	O
18.7	8.1	Wh
20.7	8.2	Ba
22.6	8.1	O
27.6	8.4	O
29.5	8.3	B
32.6	8.4	Ba
37.5	8.7	O

043208
RX Tauri

1508.7	10.2	Ba
09.7	10.0	Pi
11.8	9.9	M

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

RX Tauri

J.D 242	Est.	Obs.
15.7	9.5	De
20.7	9.4	Ba
22.8	9.2	M

044617
V Tauri

J.D 242	Est.	Obs.
1508.7	9.0	Ba
11.8	9.4	M
18.8	9.2	M
20.7	8.8	Ba
22.7	9.2	De
22.8	9.1	M

045307
R Orionis

J.D 242	Est.	Obs.
1508.7	12.0	Ba
20.7	12.4	Ba

045514
R Leporis

J.D 242	Est.	Obs.
1488.7	8.8	L
1511.8	8.8	M
20.7	8.5	Ba
22.7	8.7	D

050022
T Leporis

J.D 242	Est.	Obs.
1515.8	9.7	M

050003
V Orionis

J.D 242	Est.	Obs.
1522.6	<13.0	Ba
22.7	<12.3	Wh

050953
R Aurigae

J.D 242	Est.	Obs.
1448.5	9.2	Lt
57.5	9.2	Lt
58.5	9.2	Lt
61.5	9.2	Lt
63.4	9.2	Lt
65.5	9.2	Lt
72.4	9.2	Lt
1508.7	7.0	Ba
09.8	7.5	M
11.8	7.5	M
18.7	7.6	Pi
22.6	7.4	Ba
30.6	7.5	Ba

052034
S Aurigae

J.D 242	Est.	Obs.
1508.7	8.9	Ba
11.8	9.8	M
18.7	9.1	Wh
18.7	9.7	Pi
18.8	9.5	M
22.6	8.6	Ba

052036
W Aurigae

J.D 242	Est.	Obs.
1508.7	9.4	Ba
18.7	9.0	Wh
18.8	9.4	M
22.6	8.8	Ba

052405
S Orionis

J.D 242	Est.	Obs.
1518.8	11.5	M
22.7	10.8	Ba

053068
S Camelop.

J.D 242	Est.	Obs.
1457.5	8.5	Lt
61.5	8.5	Lt
65.5	8.5	Lt
72.4	8.6	Lt
1515.5	9.3	De
15.8	9.3	M
22.6	8.9	Ba

*053005*a
T Orionis

J.D 242	Est.	Obs.
1497.6	11.2	L
1507.8	10.7	M
22.7	11.0	Ba

053326
RR Tauri

J.D 242	Est.	Obs.
1515.8	<10.5	M

053531
U Aurigae

J.D 242	Est.	Obs.
1508.7	9.8	Ba
18.8	9.2	M
22.6	8.8	Ba
22.7	8.9	D

054319
SU Tauri

J.D 242	Est.	Obs.
1488.6	9.6	L
89.6	9.5	L
94.6	9.6	L
97.6	9.6	L
1508.7	9.6	Ba
15.7	9.6	Wh
15.7	9.5	Ba
16.7	9.6	Ba
17.6	9.7	Ba
18.8	9.4	Pi
20.6	9.8	Ba
22.6	9.7	Ba
30.6	9.5	Ba
31.6	9.7	Ba

054920
U Orionis

J.D 242	Est.	Obs.
1511.8	9.5	M
18.8	9.3	M
22.6	9.1	Ba

054974
V Camelop.

J.D 242	Est.	Obs.
1451.5	12.6	Lt
58.5	12.8	Lt
1508.5	<13.3	Ba
08.7	<12.2	Wh
09.5	<13.0	Ba
14.5	<13.3	Ba
15.6	13.8	B
15.6	<13.0	Ba
16.5	<13.0	Ba
17.5	<13.0	Ba
18.7	<12.2	Wh
18.8	<11.3	M
20.7	<13.3	Ba
22.6	13.0	Y
22.6	<13.5	Ba
30.6	<11.9	Wh
30.6	<12.8	Ba
32.6	<12.0	Ba

055353
Z Aurigae

J.D 242	Est.	Obs.
1448.5	10.8	Lt
56.5	10.5	Lt
57.5	10.5	Lt
58.5	10.3	Lt
61.5	10.3	Lt
62.5	10.4	Lt
65.5	10.0	Lt
1508.7	10.1	Ba
11.8	9.8	M
22.6	10.4	Ba
22.7	10.6	D

060450
X Aurigae

J.D 242	Est.	Obs.
1508.7	9.0	Ba
15.6	9.4	De
18.7	9.4	Pi
18.8	9.0	M
22.6	9.0	Ba
22.6	9.8	Wh
22.7	9.8	D

060547
SS Aurigae

J.D 242	Est.	Obs.
1487.6	<11.6	L
88.6	<12.4	L
89.6	<12.4	L
90.4	<12.4	L
94.6	<12.4	L
95.6	<11.4	Pe
97.6	<12.4	L
1504.6	<10.8	Bu
05.6	<10.8	Bu
08.6	<11.6	Bu
08.6	<13.0	Ba
08.7	<12.4	De
09.6	<11.6	Bu
09.6	<13.5	Ba

SS Aurigae

J.D 242	Est.	Obs.
09.7	<11.4	Pi
14.6	<12.8	Ba
14.7	<11.0	Pi
15.6	<13.3	B
15.7	<12.8	Ba
15.7	<12.4	De
15.7	<12.4	Wh
15.8	<12.4	M
16.6	<11.4	De
16.6	<13.0	Ba
17.6	<12.7	Ba
18.6	<13.5	B
18.6	<12.4	Bu
18.7	<12.4	Pi
18.8	<11.6	M
20.6	<13.0	Ba
22.6	<13.5	B
22.6	<13.3	Ba
22.7	<12.4	Pi
22.6	<13.3	Y
24.6	<12.4	Re
24.6	<12.4	Bu
26.6	<12.4	Bu
30.6	12.1	Ba
31.6	11.3	Ba
32.6	10.5	Ba
33.7	10.8	Ba
34.6	10.5	Bu
35.6	11.0	Bu
35.6	11.2	Ba
37.5	12.0	Ba

061647
V Aurigae

J.D 242	Est.	Obs.
1515.8	10.2	M
22.6	9.0	Ba
22.7	10.2	Wh

061702
V Monoc.

J.D 242	Est.	Obs.
1515.8	7.9	M

063159
U Lyncis

J.D 242	Est.	Obs.
1516.7	13.2	Ba
22.6	11.8	Ba

063308
R Monoc.

J.D 242	Est.	Obs.
1518.9	11.0±M	

063558
S Lyncis

J.D 242	Est.	Obs.
1516.7	12.0	Ba
22.6	11.8	Ba

064030
X Gemin.

J.D 242	Est.	Obs.
1522.7	11.4	Ba

065208
X Monoc.

J.D 242	Est.	Obs.
1487.7	9.0	L
97.6	9.0	L
1518.9	9.4	M

065355
R Lyncis

J.D 242	Est.	Obs.
1516.7	<13.0	Ba

*070122*a
R Gemin.

J.D 242	Est.	Obs.
1465.6	7.6	Lt
71.6	6.9	Vo
1515.9	7.0	M
18.7	7.0	Pi
22.7	6.2	Ba

070122b
Z Gemin.

J.D 242	Est.	Obs.
1515.9	<11.6	M
22.7	12.3	Ba

070122c
TW Gemin.

J.D 242	Est.	Obs.
1515.9	8.8	M
22.7	8.5	Ba

070109
V Can. Min.

J.D 242	Est.	Obs.
1515.9	9.1	M

070310
R Can. Min.

J.D 242	Est.	Obs.
1488.7	9.3	L
97.6	9.4	L
1515.9	9.7	M

071713
V Gemin.

J.D 242	Est.	Obs.
1515.9	<11.2	M
18.7	11.0	Pi

072708
S Can. Min.

J.D 242	Est.	Obs.
1515.8	7.8	M

073508
U Can. Min.

J.D 242	Est.	Obs.
1487.7	<11.7	L
94.7	<11.9	L
97.6	<11.7	L
1521.1	<11.2	Bg

073723
S Gemin.

J.D 242	Est.	Obs.
1518.7	<12.4	Pi

074323
T Gemin.

J.D 242	Est.	Obs.
1522.9	<11.5	Bg

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

074922
U Gemin.

J.D. 242	Est.	Obs.
487.6	<10.9	L
88.6	<11.7	L
89.6	<11.7	L
94.6	<11.7	L
97.6	<11.7	L
1515.9	<10.9	M
18.7	<11.4	Pi
18.9	<11.7	M
22.7	<11.6	D
22.9	<12.3	Bg
33.7	<12.3	Ba

081112
R Cancri

1494.7	10.5	L
1518.9	10.5	M

083350
X Urs. Maj.

1522.7	10.6	Ba

084803
S Hydrae

1515.9	<11.0	M

085120
T Cancri

1494.6	9.6	L
1522.9	9.7	Bg

090151
V Urs. Maj.

1487.6	10.3	L
89.6	10.2	L
94.6	10.0	L
1515.9	10.2	M
22.7	10.4	Ba

090425
W Cancri

1515.9	10.6	M

093934
R Leo. Min.

1515.9	<10.9	M

094211
R Leonis

1494.7	7.0	L
1515.9	8.3	M

103769
R Urs. Maj.

242		
1442.4	7.6	Lt
47.4	7.6	Lt
48.4	7.1	Vo
48.6	7.4	Lt
51.4	7.0	Vo
51.4	7.4	Lt
53.4	7.2	Vo
56.4	7.2	Vo
57.4	7.2	Vo

R Urs. Maj.

242		
1457.4	7.4	Lt
58.4	7.5	Vo
58.4	7.4	Lt
60.3	7.5	Vo
60.4	7.5	Lt
61.4	7.5	Vo
61.4	7.6	Lt
64.4	7.4	Vo
65.5	7.7	Lt
66.4	7.6	Lt
69.4	7.7	Lt
72.4	7.8	Lt
74.3	7.9	Pe
77.3	7.8	Pe
79.3	7.8	Pe
81.2	7.9	Pe
87.3	8.3	Pe
94.2	8.4	Pe
99.2	8.5	Pe
1506.5	8.6	B
08.5	8.4	Ba
15.9	9.5	M
19.5	9.0	Ba
23.1	8.8	Bg

123160
T Urs. Maj.

1406.5	12.7	Lt
25.4	12.9	Lt
30.5	12.9	Lt
32.5	12.8	Lt
51.4	12.1	Lt
56.4	11.5	Lt
57.4	11.5	Lt
58.4	11.2	Lt
61.4	10.8	Lt
62.4	10.7	Lt
63.4	10.5	Lt
65.4	10.2	Lt
69.4	9.6	Lt
72.4	9.2	Lt
77.3	9.0	Pe
79.3	8.8	Pe
81.2	8.4	Pe
91.3	7.8	Pe
94.2	7.9	Pe
95.2	7.8	Pe
99.2	7.9	Pe
1504.5	7.5	B
08.5	7.7	Ba
09.5	8.1	De
16.5	7.7	Ba
19.5	7.8	Ba
23.1	8.0	Bg
32.5	7.8	Ba

123459
RS Urs. Maj.

1508.5	<12.6	Ba
09.5	<10.9	De

123961
S Urs. Maj.

J.D. 242	Est.	Obs.
1451.4	11.2	Lt
56.4	11.5	Lt
58.4	11.4	Lt
65.4	11.7	Lt
77.3	10.5	Pe
79.3	10.6	Pe
81.3	10.1	Pe
89.3	9.0	L
91.2	9.2	Pe
94.2	9.1	Pe
95.2	8.9	Pe
99.2	8.7	Pe
1504.5	8.0	B
08.5	7.8	Ba
08.6	8.4	We
09.5	8.4	De
16.5	7.8	Ba
19.5	7.6	Ba
23.1	8.3	Bg
32.5	7.7	Ba

124046
Y Can. Ven.

1448.4	5.4	Vo
51.4	5.4	Vo
56.4	5.4	Vo
58.4	5.4	Vo
68.4	5.4	Vo

131546
V Can. Ven.

1448.4	7.8	Vo
51.4	7.6	Vo
51.4	7.6	Lt
53.4	7.5	Vo
56.4	7.3	Vo
58.4	6.9	Vo
58.4	7.2	Lt
59.4	6.9	Vo
60.3	6.8	Vo
61.4	6.7	Lt
61.4	6.8	Vo
62.4	6.7	Lt
64.4	6.7	Lt
64.4	6.8	Vo
66.4	6.7	Lt
69.4	6.7	Lt
72.4	6.7	Lt

133273
T Urs. Min.

1457.5	11.9	Lt
58.4	11.9	Lt
66.4	12.2	Lt
1509.5	13.0	Ba
10.5	<11.4	V
22.5	13.2	Ba

134440
R Can. Ven.

J.D. 242	Est.	Obs.
1451.5	9.0	Lt
58.4	8.8	Lt
61.4	8.8	Lt
66.4	8.7	Lt
69.4	8.7	Lt
87.3	8.4	L
1501.5	8.4	B
09.5	8.3	Ba
11.3	8.4	L
19.5	8.2	Ba

140113
Z Bootis

1447.4	10.1	Lt
48.4	10.1	Lt
51.4	10.2	Lt

141567
U Urs. Min.

1451.5	9.7	Lt
57.5	9.5	Lt
61.4	9.2	Lt
63.4	9.2	Lt
65.5	9.2	Lt
72.4	8.9	Lt
1504.5	8.8	B
08.5	8.8	De
09.5	8.7	Ba
09.6	8.8	Pi
19.5	8.8	Ba
30.6	8.7	Ba

141954
S Bootis

1506.5	<12.0	De
09.5	12.7	Ba
13.5	12.7	B
22.5	12.5	Ba

142584
R Camelop.

1406.5	12.8	Lt
51.5	<12.6	Lt
58.4	12.8	Lt
61.4	12.5	Lt
62.4	12.7	Lt
65.5	12.6	Lt
1502.6	9.1	Wh
08.6	9.1	O
09.5	8.6	Ba
16.6	8.8	O
19.5	8.5	Ba
22.6	8.8	O
29.5	8.3	B
30.6	8.5	Ba
37.5	8.7	O

142539
V Bootis

1442.5	10.4	Lt
57.4	10.5	Lt

V Bootis

J.D. 242	Est.	Obs.
1458.4	10.5	Lt
62.4	10.6	Lt
66.4	10.5	Lt
72.4	10.5	Lt
90.3	10.3	L
1501.5	9.5	B
02.6	9.8	We
09.5	9.6	Ba
11.3	9.5	L
22.5	8.5	Ba

143227
R Bootis

1447.4	8.6	Lt
48.4	8.6	Lt
57.4	8.0	Vo
57.4	8.1	Lt
58.4	8.0	Vo
58.4	8.0	Lt
59.4	8.0	Vo
60.4	7.9	Lt
61.4	7.9	Vo
61.4	7.7	Lt
63.4	7.9	Vo
64.4	7.6	Lt
64.3	7.8	Vo
66.4	7.4	Lt
69.4	7.3	Lt
69.4	7.0	Vo
72.4	7.2	Lt
74.3	6.8	Pe
77.3	6.7	Pe
80.3	6.6	Pe
82.3	6.8	Pe
87.3	6.7	Pe
88.3	6.8	Pe
90.3	6.9	L
92.4	6.5	L
94.2	6.8	Pe
1501.5	7.5	B
06.5	7.4	De
09.5	7.6	Ba
11.3	7.9	L
22.5	8.0	Ba

151714
S Serpentis

1448.4	8.7	Lt
53.4	8.6	Lt
56.4	8.6	Lt
60.4	8.6	Lt
61.4	8.6	Lt
63.4	8.5	Lt
65.4	8.5	Lt
72.4	8.5	Lt
82.2	7.7	Pe
87.2	7.7	Pe
88.3	7.6	Pe

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

S Serpentis

J.D. 242	Est.	Obs.
1503.6	9.8	Wh
09.5	9.6	Ba
22.5	10.3	Ba

151731
S Cor. Bor.

1457.5	12.2	Lt
58.4	12.2	Lt
62.4	12.5	Lt
69.4	12.5	Lt
1502.6	<10.3	We
03.5	<10.3	De
05.5	12.2	B
09.5	12.2	Ba
16.5	11.5±De	
22.5	12.1	Ba

153378
S Urs. Min.

1457.5	11.1	Lt
65.6	11.2	Lt
72.4	11.4	Lt
1508.6	10.8	We
09.5	10.2	Ba
09.6	11.6	Pi
19.5	10.2	Ba
20.7	10.6	Bg
30.6	10.0	Ba

154428
R Cor. Bor.

1442.4	9.8	Lt
47.4	10.0	Lt
48.5	10.2	Lt
50.4	10.6	Lt
51.4	10.8	Lt
53.4	11.6	Lt
56.4	12.9	Lt
57.4	13.0	Lt
58.4	13.0	Lt
60.4	13.3	Lt
61.4	13.4	Lt
62.3	13.4	Lt
63.4	13.4	Lt
64.4	13.4	Lt
65.4	13.4	Lt
66.4	13.4	Lt
69.4	13.4	Lt
81.3	<12.6	Pe
82.3	<12.6	Pe
85.3	<12.2	Pe
86.3	<12.2	L
88.3	13.0	Pe
88.3	<12.2	L
89.3	<12.2	L
91.3	12.9	Pe
92.3	<11.4	L
94.3	<12.2	Pe
94.3	<11.4	L
95.3	<12.2	Pe
97.3	<11.4	L

S Cor. Bor.

J.D. 242	Est.	Obs.
1501.5	<12.2	B
03.5	12.9	B
04.5	<10.7	De
04.5	12.4	B
05.5	<10.7	Rd
05.5	12.6	Y
05.5	12.4	B
05.6	<12.7	Wh
06.3	<11.4	L
06.5	12.0±De	
08.5	12.0	B
08.5	12.2	Ba
08.6	12.0	Wh
09.3	<12.2	L
09.5	12.2	Ba
09.6	12.2	Bu
10.6	<11.4	V
11.3	<11.9	L
13.5	11.8	B
13.5	11.6±De	
14.5	12.1	Ba
14.6	12.3	Bu
15.5	<11.4	D
15.5	11.9	B
16.5	12.1	Ba
16.5	11.9	B
16.5	11.7	De
16.6	12.0	Hu
16.6	11.0	Bu
17.5	12.0	Ba
18.5	11.6	B
18.5	<9.8	Rd
19.5	12.0	Ba
19.5	<11.4	D
21.6	<10.7	Bg
22.5	11.6	Ba
22.5	11.5	B
22.6	11.8	Wh
29.5	<11.5	B
30.5	11.0	Ba
32.5	10.9	B
35.5	10.8	Ba
37.5	10.5	Ba

154536
X Cor. Bor.

1505.5	9.9	B
09.5	9.6	Ba
22.5	9.7	Ba

154539
V Cor. Bor.

1457.5	10.6	Lt
58.4	10.6	Lt
61.4	10.7	Lt
66.4	10.7	Lt
1509.5	7.5	Ba
16.6	8.0	Hu
22.5	7.2	Ba
22.5	7.8	Bg

154615
R Serpentis

J.D. 242	Est.	Obs.
1442.4	10.6	Lt
51.4	11.1	Lt
53.4	11.2	Lt
56.4	11.3	Lt
62.4	11.4	Lt
66.4	11.7	Lt
80.3	11.8	Pe
81.3	11.9	Pe
1509.5	12.7	Ba

154749
ST Herculis

1451.5	8.1	Lt
57.4	8.1	Lt
58.4	7.9	Lt
61.5	7.9	Lt
65.4	8.0	Lt

155229
Z Cor. Bor.

1447.4	11.2	Lt
57.5	11.3	Lt
62.4	11.0	Lt
1509.5	13.0	Ba

155847
X Herculis

1442.4	6.9	Lt
47.4	6.7	Lt
48.4	6.8	Lt
48.4	6.5	Vo
50.4	7.1	Lt
51.4	7.0	Lt
51.4	6.6	Vo
53.4	7.1	Lt
53.4	7.1	Vo
56.4	7.2	Vo
56.4	7.1	Lt
57.4	7.2	Vo
57.4	7.2	Lt
58.3	7.2	Vo
58.4	7.2	Lt
59.4	7.2	Vo
60.4	7.2	Lt
61.4	7.2	Vo
61.4	7.2	Lt
62.4	7.2	Lt
63.3	7.2	Vo
63.4	7.2	Lt
64.3	7.2	Vo
64.4	7.2	Lt
65.4	7.2	Lt
66.4	7.2	Lt
66.4	7.2	Vo
69.3	6.8	Vo
77.3	6.7	Pe
81.3	6.7	Pe
91.3	7.0	Pe
1509.5	6.5	Ba
15.6	6.5	Nt
19.5	6.5	Ba

160118
R Herculis

J.D. 242	Est.	Obs.
1509.5	<13.0	Ba
18.5	11.7	B

160150
RR Herculis

1451.4	8.8	Lt
57.4	8.7	Lt
58.4	8.8	Lt
61.5	8.8	Lt
63.5	8.8	Lt
65.4	8.8	Lt

160210
U Serpentis

1442.4	9.9	Lt
53.4	10.5	Lt
56.4	10.5	Lt
62.4	10.9	Lt
66.4	11.0	Lt
1509.5	<12.3	Ba

160325
SX Herculis

1442.5	8.7	Lt
48.4	8.6	Lt
56.4	8.2	Lt
57.4	8.2	Lt
62.4	8.0	Lt
63.4	7.9	Lt
64.4	7.9	Lt
66.4	7.9	Lt
72.4	7.8	Lt

160625
RU Herculis

1494.3	<11.0	Pe
95.3	<11.7	Pe
1509.5	12.0	Ba
15.5	11.3	B
22.5	10.4	Ba
30.6	10.5	Wh

161138
W Cor. Bor.

1505.5	11.2	B
09.5	10.7	Ba
19.5	10.7	Ba

162119
U Herculis

1442.4	8.4	Lt
51.5	8.4	Lt
57.4	8.6	Lt
60.4	8.6	Lt
61.4	8.7	Lt
63.4	8.8	Lt
64.4	8.8	Lt
65.4	8.8	Lt
72.4	9.1	Lt
85.3	8.9	Pe
87.3	9.0	Pe

U Herculis

J.D. 242	Est.	Obs.
1491.3	8.9	Pe
94.3	9.1	Pe
97.3	9.1	Pe
1502.6	9.3	We
03.6	9.0	De
04.6	9.2	O
08.6	9.4	O
09.5	9.0	Ba
16.6	9.6	O
18.5	9.3	Rd
22.5	9.1	Ba
22.5	9.1	B

162326
α Scorpii

1474.3	0.9	Hd
75.3	1.1	Hd
76.3	1.3	Hd

162542
g Herculis

1442.4	5.0	Lt
46.4	4.6	Vo
47.4	5.1	Lt
48.4	5.2	Lt
48.4	4.4	Vo
50.4	5.2	Lt
51.4	4.5	Vo
51.4	5.2	Lt
5.34	5.3	Lt
53.4	4.6	Vo
56.4	5.3	Lt
57.3	4.6	Vo
57.4	5.3	Lt
58.4	4.6	Vo
58.4	5.2	Lt
59.4	4.6	Vo
60.4	5.3	Lt
61.4	4.6	Vo
61.3	5.3	Lt
62.4	5.2	Lt
63.3	5.2	Lt
63.3	4.6	Vo
64.4	4.8	Vo
64.4	5.3	Lt
65.4	5 2	Lt
66.4	4.9	Vo
66.4	5.2	Lt
69.3	4.8	Vo
69.4	5.3	Lt
72.3	5.2	Lt
81.3	5.0	Pe

162807
SS Herculis

1442.4	12.1	Lt
47.4	11.8	Lt
48.5	11.7	Lt
56.4	10.8	Lt
57.4	10.6	Lt

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

SS Herculis

J.D. 242	Est.	Obs.
1458.4	10.1	Lt
61.4	10.0	Lt
62.4	10.0	Lt
63.4	9.9	Lt
64.4	9 9	Lt
65.4	9.7	Lt
69.4	9.4	Lt
72.4	9.4	Lt
87.3	9.0	L
1508.5	10.8	Ba
08.6	11.0	De
10.6	11.0	V
12.3	11.3	L
14.5	11.4	Ba
16.5	11.4	Ba
19.5	11.7	Ba
22.5	11.9	Ba

163172
R Urs. Min.

1448.4	9.4	Lt
57.5	9.3	Lt
61.4	9.3	Lt
64.4	9.3	Lt
65.5	9.5	Lt
1509.6	10.1	Pi
09.6	9.7	Ba
20.7	10.0	Bg
22.5	9.5	Ba
30.6	9.5	Ba

163137
W Herculis

1451.4	11.0	Lt
56.4	9.9	Lt
57.4	9.9	Lt
61.5	9.4	Lt
62.5	9.4	Lt
64.4	9.3	Lt
66.4	9.3	Lt
1509.6	7.8	Hu
09.6	8.1	Ba
15.6	8.4	De
22.5	8.1	Ba

163266
R Draconis

1442.4	7.3	Lt
47.4	7.2	Lt
48.4	7.2	Lt
51.4	7.2	Lt
53.4	7.0	Vo
56.4	7.2	Lt
56.4	7.1	Vo
57.4	7.2	Vo
57 5	7.2	Lt
58.4	7.3	Lt
58.4	7.3	Vo
59.4	7.4	Vo
60.4	7.3	Lt
61.4	7.5	Lt
61.4	7.5	Vo

R Draconis

J.D. 242	Est.	Obs.
1462.5	7.6	Lt
63.4	7.6	Vo
63.4	7.6	Lt
64.4	7.5	Vo
65.5	7.7	Lt
66.4	7.6	Vo
66.5	7.8	Lt
69.4	7.7	Lt
72.4	7.8	Lt
1503.6	9.6	De
04.6	9.4	O
06.6	9.6	Wh
08.6	9.4	O
09.5	10.0	Pi
09.6	10.0	Ba
16.6	10.5	O
20.7	11.0	Bg
22.5	10.6	Ba
22.6	10.8	B
30.6	11.0	Ba

164055
S Draconis

1457.5	9.1	Lt
61.4	8.9	Vo
63.3	9.1	Vo
65.5	9.1	Lt
1509.6	9.3	Pi
09.6	8.5	Ba
22.5	9.2	De
22.5	8.6	Ba
32.5	8.7	Ba

164715
S Herculis

1456.4	12.3	Lt
57.4	12.3	Lt
58.4	12.7	Lt
62.4	12.1	Lt
65.4	11.8	Lt
69.4	11.7	Lt
1508.6	9.4	De
09.6	8.9	Ba
30.6	9.0	Wh

165631
RV Herculis

1482.3	12.0	Pe
85.3	12.0	Pe
87.3	<12.7	Pe
88.3	12.9	Pe
91.3	12.7	Pe
94.3	12.8	Pe
95.3	12.8	Pe
1509.6	10.9	Hu
09.6	11.4	Ba
18.5	10.8	B
22.5	10.9	Ba
30.6	10.3	Wh
32.5	10.2	Ba

170627
RT Herculis

J.D. 242	Est.	Obs.
1504.6	<12.6	Y
08.6	<12.6	De
08.6	<13.0	B
09.6	<13.0	Ba
16.6	<12.8	B

171401
Z Ophiuchi

1457.5	11.0	Lt
58.4	11.0	Lt
1506.6	11.9	Y
09.6	12.2	Ba
22.5	12.3	Ba

171723
RS Herculis

1448.6	8.6	Lt
56.4	8.6	Lt
57.4	8.6	Lt
62.4	8.7	Lt
66.4	8.8	Lt
81.3	9.4	Pe
82.3	9.7	Pe
85.3	9.6	Pe
87.3	9.9	Pe
88.3	10.0	Pe
92.3	10.1	Pe
94.3	10.1	Pe
97.3	10.3	Pe
1508.6	11.6	De
09.6	10.8	Ba
10.6	11.0	V
22.5	12.1	Ba
22.6	11.8	Y
30.6	<11.3	Wh

172809
RU Ophiuchi

1509.6	13.0	Ba
16.5	<13.0	B

173457
TY Draconis

1477.3	9.0	Pe
80.3	9.1	Pe
81.3	9.2	Pe
85.3	9.3	Pe
91.3	9.4	Pe
92.3	9.4	Pe
97.3	9.4	Pe

175111
RT Ophiuchi

1509.6	<12.7	Ba
13.6	<13.0	B
30.6	<11.0	Wh

175458
T Draconis

J.D. 242	Est.	Obs.
1433.4	11.2	Lt
56.5	10.9	Lt
57.5	10.8	Lt
61.5	10.9	Lt
66.4	10.9	Lt
1509.5	10.1	Pi
09.6	10.2	Hu
10.6	10.7	V
20.7	9.6	Bg
22.6	9.3	B

175519
RY Herculis

1456.4	13.2?	Lt
57.4	13.2?	Lt
62.4	12.6	Lt
65.4	12.6	Lt
85.4	11.3	Pe
91.3	11.3	Pe
92.3	11.3	Pe
94.3	11.1	Pe
95.3	11.0	Pe
1505.5	9.7	B
08.6	9.5	De
09.6	9.2	Ba
22.5	8.8	Ba
22.6	9.2	Y

180531
T Herculis

1442.4	11.6	Lt
47.4	12.0	Lt
48.5	12.1	Lt
51.5	12.5	Lt
56.5	12.9	Lt
57.4	13.0	Lt
58.5	13.1	Lt
62.4	13.1	Lt
63.4	13.1	Lt
65.4	13.1	Lt
1502.6	10.8	We
04.5	11.0	De
06.6	10.5	Y
09.6	10.6	Ba
09.6	10.0	Hu
18.5	9.3	Rd
20.8	8.9	Bg
22.5	8.8	Ba
24.6	8.9	Bu
32.5	7.6	Ba
37.5	7.8	O

180565
W Draconis

1508.5	13.3	B
09.6	<11.8	Pi
09.6	<12.0	Ba
18.5	13.8	B
22.6	<12.5	Y

180931
TV Herculis

J.D. 242	Est.	Obs.
1483.3	10.9	L
86.3	10.2	L
88.3	<12.5	Pe
88.3	10.0	L
92.3	10.0	L
1506.3	9.9	L
09.3	10.0	L

181136
W Lyrae

1448.4	9.6	Lt
56.5	9.3	Lt
57.4	9.3	Lt
61.3	8.9	Vo
61.4	9.2	Lt
63.4	9.0	Vo
64.4	9.0	Lt
65.6	9.0	Lt
72.4	8.9	Lt
94.7	7.6	By
1500.7	7.4	By
02.6	8.0	De
02.6	8.3	We
04.6	8.6	O
08.6	8.0	O
09.6	8.3	Hu
09.6	7.9	Ba
16.6	8.6	Pi
16.6	8.6	O
18.5	8.4	Rd
18.6	8.5	Wh
22.5	8.1	Ba
22.6	8.9	O
22.7	8.7	Mu
24.6	9.4	Bu
27.6	9.1	O
29.5	9.0	B
30.6	9.2	M
32.5	9.2	Ba
37.5	9.4	O

181103
RY Ophiuchi

1451.4	<10.0	Vo
56.4	9.6	Lt
57.5	9.5	Lt
58.4	9.5	Lt
58.4	9.8	Vo
59.4	9.7	Vo
60.4	9.6	Vo
61.4	9.5	Vo
62.4	9.6	Vo
62.4	9.3	Lt
64.4	9.4	Lt
64.4	9.5	Vo
66.4	9.6	Lt
1509.6	12.5	Ba
10.6	<11.3	V
18.5	12.7	B
22.5	12.7	Ba

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

182224
SV Herculis

J.D. 242	Est.	Obs'
1508.6	11.0	De
09.6	10.9	Ba
18.6	10.4	B
22.5	10.0	Ba
22.6	10.7	Y

182306
T Serpentis

1509.6	<13.1	Ba

183225
RZ Herculis

1448.4	9.5	Lt
56.4	9.6	Lt
57.4	9.6	Lt
62.4	9.8	Lt
66.4	10.1	Lt
1508.6	11.9	De
09.6	11.8	Ba
22.5	12.5	Ba

183308
X Ophiuchi

1448.4	7.4	Lt
48.4	7.4	Vo
51.4	7.1	Vo
56.4	6.9	Vo
57.4	6.9	Vo
57.4	7.3	Lt
58.5	6.9	Vo
59.4	7.0	Vo
60.4	6.9	Vo
61.4	6.9	Vo
61.5	7.2	Lt
62.4	7.1	Vo
63.4	7.1	Vo
64.4	7.0	Lt
64.4	7.2	Vo
65.4	7.0	Lt
66.4	7.1	Vo
69.4	7.3	Vo
87.3	6.8	L
1502.6	7.9	De
09.6	7.0	Ba
10.6	7.8	V
16.7	8.2	Pi
21.7	8.1	Bg
22.5	7.8	Ba
30.6	8.0	Wh
32.5	8.2	Ba

184134
RY Lyrae

1509.6	11.7	Ba
22.5	10.7	Ba

184205
R Scuti

1442.4	5.7	Lt
46.4	5.4	Vo.

R Scuti

J.D. 242	Est.	Obs.
1447.4	5.4	Lt
48.4	5.4	Vo
48.4	5.3	Lt
51.3	5.3	Vo
51.4	5.4	Lt
53.3	5.2	Vo
53.4	5.5	Lt
56.4	5.5	Lt
56.4	5.2	Vo
57.3	6.2	Vo
57.4	5.5	Lt
58.4	5.3	Vo
58.5	5.6	Lt
59.3	5.3	Vo
60.3	5.4	Vo
60.4	5.7	Lt
61.3	5.4	Vo
61.4	5.8	Lt
62.4	5.4	Vo
62.4	5.8	Lt
63.3	5.5	Vo
63.3	5.8	Lt
64.3	5.5	Vo
64.4	5.5	Lt
65.4	5.8	Lt
66.4	5.8	Lt
66.4	5.6	Vo
69.3	5.5	Vo
69.4	5.8	Lt
72.3	5.8	Lt
74.3	5.5	Hd
75.3	6.0	Hd
76.3	6.0	Hd
77.3	5.8	Hd
79.3	6.0	Pe
81.3	6.2	Pe
82.3	6.3	Pe
85.3	6.6	Pe
86.3	6.5	Hd
86.3	6.4	L
86.3	6.4	Be
87.3	6.7	Pe
87.3	6.4	Be
88.3	6.8	Pe
89.3	6.4	Be
91.3	6.7	Pe
91.3	6.6	L
92.3	6.7	L
92.3	6.7	Pe
94.2	6.7	Pe
94.3	6.7	Be
94.3	6.6	L
95.3	6.8	Pe
97.3	6.8	L
1503.3	6.5	L
05.6	6.3	Wh
08.5	6.3	Ba
08.6	6.1	We
08.6	6.1	Bu

R Scuti

J.D. 242	Est.	Obs.
1509.3	6.1	L
09.5	6.3	Ba
09.6	6.0	Bu
14.5	6.2	Ba
15.6	6.0	Ba
15.6	5.8	Nt
16.5	5.9	Ba
17.5	5.9	Ba
18.5	6.2	De
19.5	6.0	Ba
22.5	6.1	Ba
24.6	5.9	Bu
29.6	6.0	Bu
30.5	5.7	Ba
30.5	5.6	Nt
32.5	5.6	Ba
34.6	5.6	Bu

184243
RW Lyrae

1509.6	<13.4	Ba
13.6	<14.0	B
22.6	<14.0	Ba

184433
β Lyrae

1474.3	3.9	Hd
75.3	4.1	Hd
76.3	3.6	Hd
77.3	3.5	Hd
86.3	3.6	Hd
93.3	3.6	Hd
94.3	3.5	Hd

185032
RX Lyrae

1509.6	<13.3	Ba

185243
R Lyrae

J.D. 242	Est.	Obs.
1442.4	4.3	Lt
46.4	4.3	Lt
46.4	4.5	Vo
47.4	4.3	Lt
48.4	4.3	Lt
49.4	4.5	Vo
50.4	4.3	Lt
51.4	4.4	Vo
51.4	4.2	Lt
53.3	4.4	Vo
53.4	4.3	Lt
56.3	4.2	Lt
57.4	4.2	Lt
58.3	4.1	Lt
59.3	4.4	Vo
60.4	4.1	Lt
61.3	4.1	Lt
61.3	4.4	Vo
62.3	4.2	Lt
63.3	4.4	Vo
63.3	4.2	Lt

R Lyrae

J.D. 242	Est.	Obs.
1464.4	4.2	Lt
65.4	4.2	Lt
66.4	4.4	Vo
66.4	4.2	Lt
69.3	4.4	Vo
69.4	4.2	Lt
72.4	4.2	Lt

185634
Z Lyrae

1509.6	13.0	Ba
22.6	12.3	Ba

190108
R Aquilae

1448.4	8.7	Lt
51.5	8.8	Lt
57.5	9.2	Lt
58.5	9.3	Lt
61.4	9.3	Lt
63.4	9.4	Lt
65.5	9.5	Lt
72.4	9.5	Lt
87.3	10.1	L
1509.6	10.8	Ba
10.6	10.9	V
22.6	11.1	Bg

190529
V Lyrae

1509.6	<13.0	Ba

190927
TY Aquilae

1509.6	10.8	Ba

190926
X Lyrae

1508.6	8.3	Bg
09.6	9.0	Ba
16.6	9.0	Pi
32.5	8.9	Ba

190967
U Draconis

1509.6	9.3	Hu
09.6	9.6	Ba
22.7	9.7	Ba
24.6	9.7	Bu

191007
W Aquilae

1447.4	8.5	Lt
51.5	8.2	Lt
58.5	8.5	Lt
65.4	8.5	Lt
1509.6	8.0	Ba

191019
R Sagittarii

1494.3	<11.5	Pe
1508.5	12.8	Ba

191017
T Sagittari

1492.4	<11.4	L

191033
RY Sagittarii

1486.3	9.3	L
87.3	9.4	L
88.3	9.3	L
89.3	9.3	L
91.3	9.6	L
92.3	9.5	L
1508.5	9.2	Ba
09.3	9.0	L
09.5	9.1	Ba
14.5	8.9	Ba
16.5	9.0	Ba
17.5	8.9	Ba
22.5	8.9	Ba

191350
TZ Cygni

1509.6	10.3	Ba
24.6	10.2	Bu
32.5	10.6	Ba

191319
S Sagittarii

1503.6	11.0	Y

191321
Z Sagittarii

1506.6	<12.5	Y

191637
U Lyrae

1509.6	9.3	Ba
22.7	9.0	Ba
24.6	8.3	Bu

192576
UX Draconis

1448.4	6.8	Lt
56.5	6.9	Lt
58.5	6.8	Lt
61.5	6.8	Lt
63.4	6.8	Lt
65.4	6.8	Lt

192745
AF Cygni

1442.4	7.5	Lt
46.4	7.5	Lt
47.4	7.5	Lt
48.4	7.5	Lt
53.3	7.1	Vo
53.4	7.5	Lt
57.3	7.1	Vo
57.4	7.4	Lt
59.4	7.0	Vo
60.4	7.2	Lt
61.3	6.9	Vo
61.4	7.2	Lt
63.4	6.9	Vo
64.4	6.8	Vo

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued

AF Cygni

J.D. 242	Est.	Obs.
1464.4	7.9	Lt
65.5	6.9	Lt
66.4	6.8	Vo
66.5	6.8	Lt
69.4	6.7	Vo

192928 TY Cygni

1509.6	13.5	Ba
18.6	<12.9	Y
24.6	<11.2	Re
24.6	<11.9	Bu

193311 RT Aquilae

1509.6	13.8	Ba
29.6	11.5	Bu

193449 R Cygni

1442.4	10.5	Lt
46.4	10.1	Lt
48.4	10.0	Lt
51.4	9.8	Lt
53.4	9.6	Lt
57.3	8.6	Vo
57.4	9.1	Lt
58.5	8.9	Lt
59.4	8.4	Vo
61.3	8.4	Vo
61.4	8.7	Lt
62.4	8.6	Lt
64.4	8.6	Lt
65.5	8.6	Lt
69.4	8.0	Vo
72.4	8.6	Lt
85.3	8.2	Pe
1508.6	8.5	Hu
08.7	9.0	Bg
08.7	8.8	Wh
09.6	7.8	Ba
15.6	8.4	B
15.9	8.6	M
18.7	8.2	Pi
22.7	8.3	Ba
23.6	9.0	M
32.5	8.5	Ba
37.5	9.0	O

193509 RV Aquilae

1506.6	<12.2	Wh
14.6	13.1	Ba
29.6	<11.5	Bu

193732 TT Cygni

1489.5	7.8	L
1508.6	7.2	Bg
08.6	8.0	Hu
09.6	8.0	De

TT Cygni

J.D. 242	Est.	Obs.
1414.6	7.4	Ba
22.7	7.4	Ba
32.5	7.4	Ba

194048 RT Cygni

1442.4	10.1	Lt
46.4	10.4	Lt
51.6	10.6	Lt
53.4	10.8	Lt
56.4	11.0	Lt
57.4	11.1	Lt
61.4	11.4	Lt
63.4	11.5	Lt
65.5	11.6	Lt
69.4	17.7	Lt
72.4	11.8	Lt
1508.6	9.4	Hu
08.7	9.9	Bg
08.7	9.3	Wh
09.6	9.5	Ba
15.6	9.6	B
18.7	9.6	Pi
22.7	9.2	Ba
23.6	9.5	M
32.5	9.0	Ba
37.5	9.1	O

194232 SY Cygni

1506.6	11.4	Y

194348 TU Cygni

1453.4	11.4	Lt
56.4	11.4	Lt
57.4	11.2	Lt
61.4	11.1	Lt
65.4	11.0	Lt
1508.6	10.7	Hu
08.7	11.0	Bg
08.7	11.0	Wh
09.6	10.6	Ba
18.6	9.8	De
22.7	10.9	Ba
23.6	11.4	M
32.5	11.6	Ba

194604 X Aquilae

1508.6	13.6	B
14.6	<13.0	Ba
16.6	<13.3	B
18.5	<12.3	De
29.6	<11.9	Bu

194632 χ Cygni

J.D. 242	Est.	Obs.
1448.4	12.1	Lt
51.4	12.3	Lt
53.4	12.2	Lt
57.4	12.4	Lt
58.4	12.6	Lt
61.4	12.6	Lt
62.4	12.6	Lt
64.4	12.8	Lt
65.4	12.9	Lt
66.4	12.9	Lt
1506.6	12.4	Y
08.6	12.0	Wh
08.7	9.9	Bg
09.6	12.0	Hu
09.7	12.1	Pi
14.6	13.3	Ba
18.6	13.0	B

194700 η Aquilae

1474.3	3.9	Hd
75.3	4.1	Hd
76.3	4.4	Hd
77.3	3.9	Hd
83.3	4.0	L
86.3	3.9	L
86.3	3.9	Hd
87.3	3.4	Be
88.3	3.7	L
89.3	3.8	Be
90.4	3.9	L
92.2	4.3	L
93.3	3.9	Hd
94.3	3.7	Be
94.3	3.5	Hd
94.3	3.6	L
97.2	4.0	L
97.3	4.1	Be
98.2	4.3	Be
1503.2	4.1	Be
03.2	3.8	L
05.2	4.2	Be
08.3	3.7	De
09.2	3.6	L
11.2	4.0	Be
11.3	3.6	L
13.3	4.2	L

195116 S Sagittae

1483.3	5.4	L
86.3	6.0	Be
86.3	6.3	L
87.3	5.9	Be
88.3	5.2	L
88.3	5.2	Be
89.2	5.2	Be
90.4	5.1	L
92	5.4	L

S Sagittae

J.D. 242	Est.	Obs.
1494.2	6.0	Be
94.3	5.9	L
97.2	5.3	Be
97.2	5.2	L
1503.2	6.0	L
04.6	5.5	O
05.2	5.3	Be
05.5	5.3	Rd
08.3	5.3	Be
08.6	5.8	O
09.2	5.7	L
09.6	5.8	O
11.3	5.9	L
11.3	5.6	Be
13.3	5.3	L
16.5	5.5	O
19.6	5.8	O
21.7	5.3	Mu
22.6	5.2	O
22.7	5.2	Mu
27.6	5.8	O
37.5	5.7	O

195849 Z Cygni

1442.5	11.1	Lt
46.4	11.3	Lt
53.4	11.7	Lt
57.4	12.0	Lt
58.5	12.0	Lt
61.3	11.2	Vo
61.4	12.3	Lt
65.5	12.6	Lt
66 4	12.9	Lt
1508.7	<12.1	Wh
14.6	12.6	Ba
18.6	12.7	Y
18.6	12.5	B
32.6	<12.1	Ba

200212 SY Aquilae

1508.6	13.0	B
14.6	<12.5	Ba
16.5	<12.5	B
18.6	<12.5	Y
19.6	<11.8	Wh
29.6	<11.8	Bu

200357 S Cygni

1507.8	<10.0	M
08.7	11.2	Wh
09.7	10.0	Pi
14.6	10.5	Ba
30.6	10.5	M
34.6	10.5	Bu

***200514* R Capricorni**

J.D. 242	Est.	Obs.
1451.5	10.5	Lt
57.6	<10.7	Lt
58.5	10.8	Lt
61.4	11.1	Lt
65.5	11.3	Lt

200647 SV Cygni

1507.8	8.6	M
08.6	8.7	Hu
09.6	9.2	Pi
14.6	8.3	Ba
22.7	8.1	Ba
22.7	8.8	Mu
32.5	8.2	Ba
34.6	8.9	Bu

200715a S Aquilae

1442.5	9.7	Lt
57.5	10.1	Lt
1509.3	12.1	L
14.6	10.9	Ba
16.6	10.8	B
16.6	10.6	Pi
18.7	10.7	De
19.6	10.6	Wh
20.8	10.8	Bg
30.6	10.4	M
32.6	9.8	Ba
34.6	10.1	Bu

200715b RW Aquilae

1514.6	9.1	Ba
16.6	9.3	B
16.6	9.2	Pi
18.5	9.1	De
19.6	9.3	Wh
20.8	9.2	Bg
30.6	8.7	M
32.6	9.2	Ba
34.6	9.6	Bu

200747 RX Cygni

1522.7	7.8	Mu

200812 RU Aquilae

1506.6	<11.7	Wh
13.6	13.6	B
14.6	13.4	Ba
22.7	<11.7	Bg

***200822* W Capricorni**

1506.6	<12.9	Y

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

200906
Z Aquilae

J.D. 242	Est.	Obs.
1504.6	10.4	Y
05.6	10.3	Wh
14.6	11.2	Ba
22.5	11.9	B

200916
R Sagittae

1448.4	9.1	Lt
56.5	9.1	Lt
57.5	9.1	Lt
61.4	9.1	Lt
63.4	9.1	Lt
65.5	9.0	Lt
1514.6	8.8	Ba
16.3	9.2	T
16.6	8.9	B
16.6	8.6	Pi
18.5	8.7	De
19.6	8.6	Wh
20.8	8.6	Bg
30.6	9.1	M
32.6	9.2	Ba

200938
RS Cygni

1447.4	8.3	Lt
53.4	8.5	Lt
57.4	8.7	Lt
60.4	8.8	Lt
61.4	8.8	Lt
65.5	8.8	Lt
66.5	8.8	Lt
72.4	8.8	Lt
89.6	8.7	L
1507.8	8.6	M
08.7	7.8	Wh
09.5	7.6	De
09.7	8.6	Pi
14.6	7.3	Ba
22.7	7.7	Ba
32.6	8.0	Ba
34.6	8.9	Bu

201008
R Delphini

1503.6	9.0	Wh
04.6	9.0	O
05.6	8.7	B
09.6	8.9	O
14.6	8.5	Ba
16.6	8.6	O
18.6	8.4	Wh
22.6	8.6	O
22.7	8.4	Bg
30.6	8.4	M
34.6	8.7	Bu
37.5	8.7	O

201121
RT Capricorni

J.D. 242	Est.	Obs.
1492.4	7.2	L
1505.6	7.0	Wh
08.6	7.8	We
13.3	7.1	L
14.6	6.6	Ba

201130
SX Cygni

1448.6	9.5	Lt
53.4	9.4	Lt
57.4	9.4	Lt
61.4	9.4	Lt
63.4	9.3	Lt
66.4	9.2	Lt
1514.6	9.6	Ba
15.5	10.6	De
18.6	9.8	Y
23.7	9.4	M
34.6	10.9	Bu

201647
U Cygni

1453.4	9.5	Lt
57.4	9.6	Lt
61.4	9.7	Lt
62.4	9.8	Lt
65.6	9.9	Lt
72.4	10.0	Lt
1507.8	9.0	M
08.6	8.5	D
08.7	9.7	Wh
09.6	9.3	De
09.6	9.8	Pi
14.6	8.2	Ba
22.7	8.1	Ba
22.7	8.6	Mu
22.8	9.1	Bg
32.5	8.2	Ba
34.6	9.6	Bu

202539
RW Cygni

1489.6	9.1	L
1507.8	8.8	M
08.7	8.0	Wh
09.6	8.9	Pi
14.6	7.8	Ba
22.6	7.7	Ba
22.8	8.4	Bg
34.6	8.9	Bu

202622
RU Capricorni

1506.6	11.2	Y

202817
Z Delphini

1506.6 <	11.7	Wh
15.6	13.5	B
15.6 <	13.7	Ba

202954
ST Cygni

J.D. 242	Est.	Obs.
1448.5	10.7	Lt
53.4	10.2	Lt
57.4	10.2	Lt
61.4	10.1	Lt
66.4	10.0	Lt
1507.8	11.7	M
08.6	11.0	Hu
09.6	11.6	Pi
15.6	11.5	Ba
15.8	12.0	Y

202946
SZ Cygni

1489.6	9.1	L
94.6	9.7	L
1507.8	9.6	M
08.6	9.5	Hu
08.6	9.0	Ba
08.7	9.5	Wh
09.6	9.6	Pi
09.6	9.2	Ba
14.5	9.6	Ba
15.6	9.4	Ba
16.6	8.9	Ba
17.5	8.8	Ba
19.6	8.9	Ba
20.6	8.9	Ba
22.6	9.0	Ba
30.6	9.3	Ba
31.6	9.2	Ba
32.5	9.0	Ba

203226
V Vulpec.

1515.6	8.4	Ba
22.6	8.8	Wh

203611
Y Delphini

1502.6 <	11.7	Wh
15.6 <	13.3	Ba
18.5	13.5	B
18.6 <	12.4	Y

203816
S Delphini

1417.5	9.4	Lt
25.4	9.1	Lt
48.4	9.6	Lt
56.5	9.8	Lt
57.4	9.8	Lt
58.4	9.8	Lt
62.5	10.0	Lt
64.4	10.0	Lt
66.4	10.0	Lt
1502.7	9.5	Wh
15.6	9.0	Ba
18.6	8.9	Y
22.5	9.2	B
22.6	10.0	De

203847
V Cygni

J.D. 242	Est.	Obs.
1508.6	10.4	D
15.6	9.5	Ba
22.8	10.5	Bg

203905
Y Aquarii

1482.4 <	12.2	Pe
1513.5 <	13.0	Y

204016
T Delphini

1448.4	11.4	Lt
57.4	11.7	Lt
58.4	11.8	Lt
64.4	12.0	Lt
1504.5	12.5±	Y
09.6 <	12.0	Wh
15.6 <	13.3	Ba
15.6	14.1	B
16.7 <	12.2	Pi
18.6 <	12.8	Y

204017
U Delphini

1442.4	6.5	Lt
47.4	6.5	Lt
48.4	6.5	Lt
48.4	6.6	Vo
51.4	6.4	Lt
51.4	6.5	Vo
53.4	6.5	Lt
53.4	6.5	Vo
56.4	6.6	Vo
56.4	6.3	Lt
57.4	6.6	Vo
57.4	6.4	Lt
58.4	6.4	Lt
58.4	6.6	Vo
59.4	6.7	Vo
60.4	6.8	Vo
61.4	6.8	Vo
61.4	6.4	Lt
62.4	6.5	Lt
62.4	6.8	Vo
63.4	6.7	Vo
63.4	6.5	Lt
64.3	6.6	Vo
64.4	6.5	Lt
65.4	6.5	Lt
66.4	6.7	Vo
66.4	6.5	Lt
69.3	6.6	Vo
69.4	6.5	Lt
72.4	6.5	Lt
86.3	6.8	Be
87.3	6.7	Be
90.4	6.7	L
94.3	6.5	L
1508.3	6.6	Be
11.3	6.6	L

204104
W Aquarii

J.D. 242	Est.	Obs.
1481.4 <	13.2	Pe
82.4 <	12.1	Pe
1506.6	13.7	Y

204215
U Capricorni

1506.6	12.9	Y

204318
V Delphini

1503.7 <	11.8	Wh
06.6 <	13.2	Y
08.5	13.4	B
15.6 <	12.6	Ba
18.6 <	12.7	Y
18.6 <	13.0	B

204405
T Aquarii

1451.5	12.2	Lt
57.6	12.4	Lt
58.4	12.4	Lt
62.5	12.6	Lt
65.4	12.7	Lt
81.4 <	13.1	Pe
82.4 <	12.3	Pe
1505.6	11.2	Wh
09.6	8.9	Hu
15.6	10.5	Ba
18.5	10.3	De

204846
RZ Cygni

1513.6	11.9	Y
15.6	12.0	Ba

205017
X Delphini

1508.6 <	12.4	Wh
15.6	12.5	Ba
16.6	12 8	B
18.6	12.8	Y
22.5	12.6	De

205030
UX Cygni

1448.4	11.6	Lt
53.4	11.5	Lt
57.4	11.6	Lt
61.4	11.5	Lt
66.4	11.5	Lt

205923
R Vulpeculae

1505.6	8.6	Wh
08.6	9.8	Hu
14.6	8.0	Ba
23.7	7.9	M
24.7	7.7	Bg
32.6	8.0	Ba

VARIABLE STAR OBSERVATIONS Oct.-Nov., 1917—Continued.

210116
RS Capricorni

J.D. 242	Est.	Obs.
1505.6	8.4	Wh
05.6	8.4	Bu
12.3	8.4	L
16.5	7.8	Ba
32.6	7.9	Ba

210129
TW Cygni

J.D. 242	Est.	Obs.
1453.4	12.1	Lt
57.4	12.3	Lt
62.4	12.5	Lt
1510.6	<11.6	V
16.5	13.5	Ba
22.6	<13.2	Y

210221
X Capricorni

J.D. 242	Est.	Obs.
1506.6	13.1	Y

210382
X Cephei

J.D. 242	Est.	Obs.
1522.6	<13.0	Y

210504
RS Aquarii

J.D. 242	Est.	Obs.
1504.5	10.1	Y
09.6	10.1	Bu

210516
Z Capricorni

J.D. 242	Est.	Obs.
1506.6	10.8	Y

210868
T Cephei

J.D. 242	Est.	Obs.
1446.4	10.2	Vo
51.4	10.0	Lt
57.4	9.7	Vo
57.4	9.7	Lt
58.4	9.5	Vo
58.5	9.6	Lt
59.4	9.5	Vo
61.5	9.3	Lt
63.4	9.4	Vo
63.4	9.3	Lt
65.5	9.1	Lt
66.4	9.3	Vo
69.4	9.2	Vo
69.4	8.9	Lt
94.3	8.5	L
1504.6	8.5	O
09.6	8.2	O
09.6	8.0	Hu
09.6	7.6	D
16.5	7.2	Ba
22.6	8.0	O
24.8	8.2	Bg
32.6	7.2	Ba
37.5	8.0	O

210903
RR Aquarii

J.D. 242	Est.	Obs.
1513.6	10.0	Y

211615
T Capricorni

J.D. 242	Est.	Obs.
1513.6	11.6	Y
16.5	11.5	Ba

211614
X Pegasi

J.D. 242	Est.	Obs.
1516.5	9.7	Ba

213244
W Cygni

J.D. 242	Est.	Obs.
1442.4	5.9	Lt
47.4	6.1	Lt
48.4	6.0	Vo
48.3	6.0	Lt
51.4	6.2	Lt
53.4	6.2	Lt
53.4	5.7	Vo
56.3	6.1	Lt
56.4	5.6	Vo
57.4	6.1	Lt
57.4	5.7	Vo
58.3	6.2	Lt
58.4	5.9	Vo
59.4	6.0	Vo
60.4	5.9	Vo
61.4	6.1	Lt
62.4	5.9	Vo
62.4	6.2	Lt
63.3	6.2	Lt
63.3	6.0	Vo
64.4	6.2	Lt
64.4	6.0	Vo
65.4	6.2	Lt
66.3	6.2	Lt
66.4	6.3	Vo
69.3	6.3	Vo
72.4	6.2	Lt
77.3	6.4	Pe
79.3	6.5	Pe
81.2	6.5	Pe
87.3	5.9	L
94.2	6.8	Pe
94.3	5.9	L
97.3	5.9	L
1509.3	5.9	L

213678
S Cephei

J.D. 242	Est.	Obs.
1457.3	10.0	Lt
63.4	10.0	Lt
63.4	<10.7	Vo
65.5	10.1	Lt
72.4	10.0	Lt
1508.5	10.3	D
09.6	9.3	Hu
16.5	9.2	Ba

213753
RU Cygni

J.D. 242	Est.	Obs.
1448.5	9.0	Lt
53.4	8.9	Lt
57.4	8.8	Lt
61.4	8.7	Lt
66.4	8.7	Lt
89.6	8.4	L
1509.5	7.5	De
09.5	8.0	Pi
15.8	7.7	M
16.6	7.3	Ba
24.7	7.9	Bg

213843
SS Cygni

J.D. 242	Est.	Obs.
1442.4	12.0	Lt
46.4	12.0	Lt
46.4	<10.0	Vo
47.4	11.9	Lt
48.4	12.0	Lt
51.4	11.8	Lt
53.4	11.9	Lt
56.4	10.8	Lt
57.4	10.3	Lt
58.4	10.1	Lt
58.4	<9.6	Vo
59.4	<9.6	Vo
60.4	9.5	Lt
61.3	9.6	Vo
61.4	9.2	Lt
62.4	8.7	Lt
62.4	8.6	Vo
63.4	8.4	Lt
63.4	8.4	Vo
64.4	8.6	Vo
64.4	8.4	Lt
65.4	8.7	Lt
65.4	8.7	Vo
66.4	9.1	Lt
66.4	8.9	Vo
69.4	<9.0	Vo
69.4	9.9	Lt
72.3	11.0	Lt
77.3	11.4	Pe
79.3	12.1	Pe
80.3	11.9	Pe
81.2	12.0	Pe
86.2	11.4	L
87.3	11.4	L
88.3	11.3	L
89.5	11.3	L
91.2	11.7	Pe
94.2	11.6	Pe
94.2	11.1	L
95.2	11.8	Pe
97.2	11.1	L
1501.5	11.6	B
02.3	11.0	T

SS Cygni

J.D. 242	Est.	Obs.
1503.3	11.0	T
03.5	11.6	B
03.8	<10.4	M
04.4	11.0	T
04.5	11.8	De
04.5	11.6	B
04.6	<10.0	O
04.6	11.8	Bu
04.6	11.5	Pi
05.5	11.5	B
05.5	11.2	D
05.6	11.9	Bu
06.3	11.4	T
06.5	11.8	B
06.5	11.3	D
06.6	<11.3	Pi
07.3	11.4	T
07.8	12.0	M
08.5	11.6	Ba
08.5	11.3	D
08.5	11.6	B
08.6	11.9	Hu
08.6	11.8	Bu
08.6	11.9	De
08.7	11.4	Wh
09.2	11.2	L
09.5	11.2	D
09.5	11.5	Pi
09.5	11.5	Ba
09.6	<10.4	O
09.6	11.6	De
09.6	11.4	Bu
13.3	11.0	T
13.5	11.3	D
14.3	11.3	T
14.5	11.5	Ba
14.6	11.7	Bu
14.7	11.9	Pi
15.5	11.3	D
15.5	11.3	B
15.6	12.1	Nt
15.6	11.5	Ba
15.6	11.3	Hu
15.6	11.6	De
15.6	<11.7	V
15.8	11.8	M
16.5	11.4	Ba
16.5	11.5	D
16.6	<10.9	Bu
16.6	<10.4	O
16.6	11.3	Hu
16.6	11.3	De
16.7	12.0	Pi
17.5	11.4	Ba
17.5	11.5	D
18.5	11.4	D
18.5	11.5	B

SS Cygni

J.D. 242	Est.	Obs.
18.6	11.8	Re
18.6	11.0	Y
18.6	11.8	Bu
18.6	11.6	Hu
18.6	11.7	De
18.6	11.5	D
18.7	11.7	Wh
18.8	<11.3	M
19.5	11.5	Ba
19.5	11.6	D
19.5	11.5	B
19.6	<10.0	O
20.5	11.2	D
20.6	11.1	Ba
21.5	10.7	D
21.6	10.6	D
22.4	9.1	T
22.5	8.6	Ba
22.5	9.0±	D
22.5	8.7	B
22.6	8.7	D
22.6	8.3	O
22.6	8.7	Y
22.6	8.7	Wh
22.7	8.4	Mu
22.7	8.3	Pi
23.6	8.2	M
24.5	8.5	D
24.6	8.5	D
24.6	8.2	Bu
24.6	8.1	S
24.6	8.3	O
24.6	8.7	Y
24.6	8.2	Hu
24.6	8.3	Re
24.7	8.2	Wh
26.6	8.3	Bu
27.6	8.6	D
27.6	8.3	O
28.4	9.1	T
29.5	8.6	D
29.6	8.3	Bu
30.5	8.8	Ba
30.5	8.6	D
30.6	8.7	Wh
30.6	8.7	M
31.6	8.9	Ba
32.5	9.1	Ba
32.6	9.2	Wh
33.7	9.2	Ba
34.6	9.8	O
34.6	9.9	Bu
35.6	9.9	Ba
35.6	9.7	Re
35.6	10.0	Bu
37.5	10.8	Ba
37.5	10.4	O

VARIABLE STAR OBSERVATIONS, Oct.-Nov., 1917—Continued.

213937
RV Cygni

J.D. 242	Est.	Obs.
1489.6	6.5	L
1508.6	7.5	Hu
09.5	8.0	Pi
16.5	6.6	Ba
21.6	8.1	M
22.7	6.6	Ba
32.6	6.8	Ba

214024
RR Pegasi

1502.6	9.3	Wh
16.5	9.0	Ba
18.6	9.4	De
18.7	9.1	Wh

215605
V Pegasi

1513.6	9.6	Y
16.6	9.0	Ba
18.6	9.7	De
22.7	9.3	Wh

215717
U Aquarii

1513.6	<13.2	Y

215934
RT Pegasi

1515.6	<11.7	V
16.6	12.4	Ba

220412
T Pegasi

1504.5	<12.0	Y
16.6	<13.5	Ba

220613
Y Pegasi

1515.6	10.3	V
16.6	9.9	Ba

220714
RS Pegasi

1515.6	<11.7	V
16.6	13.5	Ba

221722
RT Aquarii

J.D. 242	Est.	Obs.
1513.6	10.4	Y

222129
RV Pegasi

1516.6	<12.5	Bu

222439
S Lacertae

1456.4	<9.0	Vo
57.4	<9.0	Vo
58.4	9.1	Vo
60.4	9.0	Vo
61.4	9.0	Vo
62.4	8.8	Vo
1504.6	8.8	O
04.6	8.8	Y
06.6	8.5	B
08.7	8.7	Wh
16.6	9.2	Ba

223841
R Lacertae

1442.4	9.6	Lt
51.5	9.8	Lt
57.6	10.0	Lt
60.4	10.0	Lt
61.4	10.0	Lt
66.4	10.2	Lt

225120
S Aquarii

1505.6	<10.7	Bu
13.6	13.8	B
16.6	13.8	Ba
18.6	<11.0	Wh

225914
RW Pegasi

1462.4	13.0	Lt
65.5	13.2?	Lt
1509.6	11.0	Bu
16.6	11.0	Ba
18.6	11.0	De
22.7	10.7	Mu
22.7	11.3	Wh
32.6	11.2	Ba

230110
R Pegasi

J.D. 242	Est.	Obs.
1462.5	<13.2?	Lt
65.5	13.2?	Lt
79.3	12.8	Pe
81.3	12.8	Pe
82.3	12.8	Pe
87.3	12.4	Pe
92.3	12.2	Pe
94.3	12.1	Pe
97.3	<11.9	Pe
1509.6	11.5	Bu
15.6	<12.0	Hu
16.6	11.6	Ba
16.7	11.0±Pi	
18.6	11.5	De
22.7	11.4	Wh

230759
V Cassiop.

1442.4	9.1	Lt
51.4	8.5	Lt
53.4	8.3	Vo
56.4	8.3	Vo
57.4	8.3	Vo
57.5	8.1	Lt
58.4	8.1	Vo
59.4	8.1	Vo
61.4	8.1	Vo
61.4	7.8	Lt
63.4	7.8	Vo
66.4	7.4	Vo
66.4	7.5	Lt
69.4	7.1	Vo
69.4	7.4	Lt
77.3	7.1	Pe
79.3	7.0	Pe
80.3	7.1	Pe
81.3	7.1	Pe
87.3	7.2	Pe
88.3	7.2	Pe
91.2	7.3	Pe
95.3	7.4	Pe
99.2	7.7	Pe
1504.5	8.4	De
05.6	8.5	Bu
08.6	8.4	O
08.6	8.3	Hu

V Cassiop.

J.D. 242	Est.	Obs.
09.7	8.3	Bg
16.6	8.5	Ba
16.6	9.0	O
16.6	8.5	Wh
18.7	9.2	Pi
18.8	9.3	M
22.5	9.0	B
22.6	9.1	O
32.6	9.1	Ba
37.5	9.8	O

231425
W Pegasi

1516.6	12.3	Ba
16.7	12.0±	Pi

231508
S Pegasi

1479.3	12.3	Pe
81.3	12.2	Pe
87.3	12.2	Pe
94.3	12.7	Pe
1513.6	13.0	Y
16.6	12.3	Ba

232848
Z Androm.

1509.6	8.7	Bu

233335
ST Androm.

1504.5	10.0	B
08.6	10.0	Hu
09.6	10.5	Bu
16.6	10.5	Ba
18.8	10.5	M
22.6	10.8	De

233815
R Aquarii

1457.5	9.5?	Lt
65.5	9.0	Lt
66.5	9.0	Lt
88.3	6.6	L
90.4	6.7	Pe

R Aquarii

J.D. 242	Est.	Obs.
93.4	6.6	Pe
94.4	6.6	Pe
96.3	6.7	Pe
1505.6	6.3	Bu
08.8	7.0	By
09.3	6.3	L
16.6	6.0	Ba
18.7	6.2	Wh

235182
V Cephei

1453.5	6.3	Lt
57.4	6.3	Lt
61.5	6.2	Lt
65.5	6.2	Lt

235209
V Ceti

1516.6	11.6	Ba

235350
R Cassiop.

1451.4	12.4	Lt
57.5	12.6	Lt
58.5	12.6	Lt
61.5	12.6	Lt
63.4	12.6	Lt
65.5	12.6	Lt
1509.5	10.7	D
17.5	12.7	Ba

235525
Z Pegasi

1504.6	9.1	O
08.6	9.1	O
09.6	9.2	Bu
15.6	8.4	V
16.6	8.5	Ba
16.6	8.6	O
22.6	8.6	O
22.7	8.5	Wh
37.5	8.6	O

235939
SV Androm.

1508.6	<12.7	De
09.6	<12.3	Bu
16.6	12.7	Ba

No. of Observations 2592; No. of Stars Observed 269; No. of Observers 28.

Mr. Bancroft's list of 410 observations of 204 variables was one of exceptional merit, a capital example of the valuable work that can be done in this line. Mr. Delmhorst, one of new recruits, is to be congratulated on the good progress he is making. We welcome Miss Young's return this month to the ranks of active observers. Miss Young observed many faint and neglected variables.

Mr. Mundt is to be congratulated on his appointment as Teaching Fellow at the University of California, and Mr. Burbeck for his very excellent translation published in the November issue of "POPULAR ASTRONOMY."

During the past month maxima of the irregular variables 060547 SS Aurigae and 213843 SS Cygni were observed.

The following calculated dates of maxima are cited from Dr. Hartwig's Catalogue, and from H. C. O. Circular, Number 197, in which Mr. Leon Campbell's calculations are recorded.

December	Hartwig		Campbell
1	205017	X Delphini	Mar. 18
2	134440	R Can. Ven.	Nov. 7
4	200357	S Cygni	Oct. 11
6	*022000*	R Ceti	Nov. 12
8	201008	R Delphini	Oct. 16
9	*045514*	R Leporis	Jan. 1
10	064030	X Geminorum	Apr. 7
11	004132	RW Andromedae	Nov. 30
15	083350	X Urs. Maj.	Oct. 30
21	160127	RR Herculis	
24	190967	U Draconis	Oct. 12
30	231508	S Pegasi	May 5
30	*233815*	R Aquarii	Oct. 14

Observations of the above named variables on the specified dates will be of special interest and value.

During the past month maxima of the following variables were observed: *021403 o* Ceti, 043274 X Camelop., 142584 R Camelop., 181136 W Lyrae, 201008 R Delphini, and 230759 V Cassiopeiae.

The next report will contain an account of the meeting at Cambridge and a list of the Charter Members of the Association.

The following observers contributed to this report: Messrs. Bancroft, Benini Bouton, Bolfing, Bryan, Burbeck, Dawson, Delmhorst, DePerrot, Ducharme, Houdard, Hunter, Lacchini, Luyten, McAteer, Mundt, Nolte, Olcott, D. B. Pickering, Reardon, Vogelenzang, Vrooman, Whitehorn, Yendell, Misses Reed, Swartz, Weber, Young.

WILLIAM TYLER OLCOTT,
Corresponding Secretary.

Norwich, Conn.
November 10, 1917.

COMET AND ASTEROID NOTES.

Ephemeris of Encke's Comet.

1918 Gr. Midnight	α h m s	δ ° ′ ″	log r	log Δ
Jan. 4	23 03 04	+ 3 25 43	0.19116	0.22876
8	23 06 58	+ 3 42 23	0.17612	0.22829
12	23 11 16	+ 4 02 03	0.16014	0.22689
16	23 15 58	+ 4 24 39	0.14320	0.22458
20	23 21 02	+ 4 49 52	0.12508	0.22117
24	23 26 30	+ 5 18 00	0.10574	0.21674
28	23 32 21	+ 5 48 40	0.08496	0.21109
Feb. 1	23 38 35	+ 6 21 54	0.06252	0.20412
5	23 45 13	+ 6 57 29	0.03822	0.19572
9	23 52 17	+ 7 35 13	0.01176	0.18569
13	23 59 47	+ 8 15 00	9.98282	0.17391
17	0 07 44	+ 8 56 11	9.95092	0.16002
21	0 16 08	+ 9 38 14	9.91556	0.14373
25	0 24 57	+10 19 58	9.87608	0.12459
Mar. 1	0 34 12	+10 59 33	9.83182	0.10203
5	0 43 41	+11 33 50	9.78196	0.07518

FRANK E. SEAGRAVE.

Ephemeris of Schaumasse's Comet b 1917.

1918 Gr. Midn.	α h m s	δ ° ′ ″	log *r*	log Δ
Jan. 1	8 52 53	−8 08 25	0.54462	0.43587
5	8 45 18	−7 57 23	0.55022	0.43680
9	8 37 37	−7 42 52	0.55578	0.43876
13	8 29 54	−7 24 54	0.56126	0.44181
17	8 21 59	−7 03 04	0.56712	0.44656
♌ 21	8 14 40	−6 39 55	0.57212	0.45137
25	8 07 25	−6 14 15	0.57706	0.45722
29	8 00 22	−5 46 18	0.58216	0.46434
Feb. 2	7 53 40	−5 16 39	0.58720	0.47238
6	7 47 18	−4 45 57	0.59214	0.48119

FRANK E. SEAGRAVE.

GENERAL NOTES.

Professor Dr. Edmund Weiss, Emeritus director of the Vienna University Observatory, died on June 21, 1917, in the eightieth year of his age. He was appointed assistant at the Vienna Observatory in 1858, became Professor in Astronomy in 1875, and was appointed director in succession to von Littrow in 1878. His revision of Oeltzen's catalogue of Argelander's Southern Zones is well known to astronomers.

Dr. Friedrich Robert Helmert, Professor in the Berlin University and director of the Prussian Geodetic Institute at Potsdam, and of the Centralbureau of the International Latitude Service, died on June 15, 1917, at the age of 73. He has been best known for his work on geodesy and related problems. His treatise on the Method of Least Squares is a standard work upon that subject.

M. Painlevé, the Premier of France, is well known as one of the most eminent of living mathematicians. He is a member of the Institute of France and has held mathematical professorships at the University of Paris and the École Polytechnique. He is one of the eighteen honorary members of the London Mathematical Society. Some of his most notable researches relate to the Problem of Three Bodies, which gives him one link of connection with astronomy.

The Spectrum of Lightning.—In the *Lowell Observatory Bulletin* No. 79 Mr. V. M. Slipher gives the results of a study of two spectrograms of lightning, obtained with a slit spectrograph on the evening of July 24, 1917. On one of the plates the spark spectrum of iron-vanadium was photographed, so that the wave-lengths of the lines in the lightning spectrum could be determined by direct comparison. The resulting wave-lengths of 55 lines are given, together with the wave-lengths of lines in corresponding positions in the spectrum of air, as determined by Neovius and Trowbridge and Hutchins. In all cases the accordance is so close between the wave-lengths and intensities of the lines in the two spectra that there can be little doubt of their identity. The lines are, with few exceptions, those due to the elements nitrogen and oxygen. The hydrogen lines, if present, are so blended with other lines as to be quite invisible.

Photographs of the spectrum of lightning had been obtained earlier by Pickering and Fox, but without the use of the slit, so that the wave-lengths of the lines could not be determined with so great accuracy.

The Beginning of the Astronomical Day.—The question has recently been raised in England whether the astronomical day should not be set back twelve hours, so as to begin at midnight instead of at noon. It is stated by those advocating the change that the practical considerations of those using the Nautical Almanacs should prevail as against the usage of astronomers. The opinion of American astronomers has been requested and a committee of the American Astronomical Society has been appointed to collect information for presentation at the next meeting of the Society.

The Committee desires to obtain an expression of opinion on this subject from as large a number as possible of astronomers, geodesists, surveyors, navigators, and all others who have occasion to use Nautical Almanacs.

Communications may be sent direct to W. S. Eichelberger, Director of the Nautical Almanac, U. S. Naval Observatory, Washington, D. C., or possibly better to some journal where a public expression of opinion may stir up further discussion.

W. S. EICHELBERGER.
Chairman.

POPULAR ASTRONOMY will be very glad to publish brief communications on the question raised by Professor Eichelberger. It is the opinion of the editors that it would be more convenient in general to have the astronomical day agree with the civil day. Astronomers whose work is mostly in the night time are accustomed to recording the times of their observations by a 24-hour clock, so that it is just as convenient to have 0^h at midnight as at noon.

Frightened at a Planet.—The following clipping appeared in the Spokesman-Review of Spokane, Wash., of November 2.

"Billings, Mont., Nov. 1.—West side residents are agog tonight over the appearance of what they believe is an airplane carrying a powerful search light in the western sky, at an angle of about 25 degrees above the horizon. Many..... .....declare that they have witnessed the same spectacle every night for at least three weeks at about the same hour, 7 o'clock. The light tonight first made its appearance in the sky at a point south of due west. It appeared to soar and glide for about a quarter of an hour, and then seemed to volplane to the earth."

How relieved in mind the West Side citizens of Billings would have been had they known this great searchlight was the planet Venus. A. D. C.

The Equator Defined.—Question in an examination in astronomy: "What is the Equator?"

Answer by an inattentive boy: "A menagerie lion running round the world."

THE ULTIMATE GOAL.

Out of the infinite reaches of space,
Age after age as the centuries roll,
The earth keeps her eager, unvarying pace,
Sweeping toward Vega, the ultimate goal.

Star-dust and nebula, breasting the cold,
Chaos, and world,—for her journey was far,—
Swift from the hand of her Maker she rolled,
True in her course to that beckoning star.

Nearer suns lure her, she heeds not, nor hears;
Darker worlds lurk in the shadows hard by;
Deaf to the ravishing song of the spheres,
Onward she speeds to the outermost sky.

Millions of ages shall pass as a day,
Darkness may claim her and death seek her soul;
Chaos and dust, she will keep on her way,
Ever toward Vega, the ultimate goal.

JOHN ERVIN STONE.